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ABSTRACT

Part I (General Strategies, Lessons and Issues) of this two-part analysis of the microcomputerization process describes strategies schools have followed in their microcomputerization efforts and the lessons and issues that have emerged. Part I covers the following: strategies for introducing microcomputers into the curriculum (the saturation, selective, individual supportive and departmental supportive models); general lessons (academic leadership, faculty comfort with computers, "real" cost of computerization, rate of computerization, and the "age myth"); strategic issues (lack of goals, evaluation, incentives and rewards, management leadership, campus relationships, and funding sources); operational issues (short-term planning, role of mainframes, equipment obsolescence and maintenance, staffing, and the budgetary process); and instructional issues (selection of courses to be integrated, faculty responsibility, teaching style and motivation, equipment barriers, courseware and software constraints, lack of data, courseware development support, and student in-class use of computers). Part II, a case study of the microcomputerization experience at the University of California at Los Angeles (UCLA) Graduate School of Management, covers the decision process, the social-technical environment, the hardware allocation process, curriculum integration, impact of the microcomputerization effort, and a projection of the school's computing environment in 1990. A budget analysis is appended. (KM)

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THE MICROCOMPUTERIZATION OF BUSINESS SCHOOLS:

Part I: General Strategies, Lessons, and Issues

Part II: A Case Study of the UCLA Graduate School of Management

Jason L. Frand

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THE MICROCOMPUTERIZATION OF BUSINESS SCHOOLS:

Part I: General Strategies, Lessons, and Issues

Part II: A Case Study of the UCLA Graduate School of Management

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Foreword by
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Foreword

Although there remain some serious skeptics regarding the role of computer integration, we at the Graduate School of Management firmly believe that the information revolution is radically changing business management systems and processes. Managers in the future will not only make decisions differently than in the past, they will also be asked to make decisions that were not a part of their set of responsibilities in the past.

To better sensitize our students and faculty to this revolution so that they may be leaders and not followers in this process, we have made a firm commitment to fundamentally integrate our curriculum in such a manner that we too change the way we think about training managers.

In a very real sense, the challenge before us remains since we have only instituted the first steps of equipment acquisition, familiarity, training and integration. Nonetheless, it is apparent that from a management perspective we will never be the same again. Whether we are planning a whole course, or one exercise, an entire research project (e.g., experimental economics), or a component of it, or simply determining how we can organizationally restructure ourselves to increase the productivity of our ancillary personnel, our *instinctive* inclination has evolved to one of initially focusing on the role this new technology can play in helping to achieve our goals. This evolution obviously further encourages us that we are on the right track if we too are so obviously affected by this new environment.

The response of our students after they graduate is even more impressive. Here too, it is quite clear that the training, exposure and insights that we have given them are extremely valuable to them as managers. Further, when we have shared our plans for the future emphasizing increased integration, they are strongly supportive of our direction and goals.

Given this GSM commitment, if one were to ask what have been the critical elements for our success, I would state them as follows:

- a dedicated, energetic. ·ring and responsive computer center staff,
- a *majority* of the faculty committed to the integration goal at some or all levels (i.e., personal productivity, teaching, research), and
- an on-going, candid, dialogue with our hardware and software vendors (e.g., Hewlett-Packard, IBM, and Ashton-Tate).

In terms of the latter, it is critical that the donor vendor enter into a substantive dialogue with you concerning your plans and strategies so that they can share with you their experiences and insights. We feel extremely fortunate in that regard. Both with respect to Hewlett-Packard and IBM, we have literally spent hundreds of hours with them here and at their various locations mutually exploring how they view the future and our role in it compared to our own vision. Without this level of cooperation and support, we would have made a lot more errors and become frustrated by our lack of progress. We have just begun this process with Ashton-Tate, but here too we are deeply indebted to them for their technical assistance and willingness to explore new applications.

A first rate professional staff is critical because of the immense importance of proper training as well as the interdependent nature of the computer integration process (i.e., if any major step fails, the whole process is doomed). Even more important than their technical abilities, the staff must have enormous resiliency, professionalism, and patience in dealing with all the inherent frustrations involved in this process. Their personal attitude toward faculty and students must always be one of serving the client and not insulting or mocking the client's temporary ignorance which is so often the case with technical staff. We here at GSM are indeed fortunate to have exemplary professional staff whose reputation is one of unswerving dedication to aiding their clients and rapidly learning from their mistakes.

Finally, due to its enormous resource implications, the administration must enlist the support of virtually the entire faculty or the experiment will fail due to the jealousy and divisiveness so often familiar to academic settings. Here again, GSM has had a faculty that firmly believes in the overall importance of our efforts toward comprehensive computer integration.

The following excellent document by Dr. Jason Frand greatly expands on many of these points as well as providing a superb detailed history of GSM's progress and future plans. It further highlights the fact that this fundamental change in training managers of the future is indeed an exciting process but one which must be carefully managed if it is to generate its promised potential. For those of us in University settings, patience is indeed a virtue, humility a constant watchdog, and enthusiasm a very necessary catalyst.

Michael Granfield
Associate Dean, Graduate School of Management, UCLA
January, 1987

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Part I: General Strategies, Lessons and Issues

Without question, the microcomputerization of our schools is firmly underway. The objective of this paper is to provide information to deans, faculty members, and computer center directors which may be of assistance in the formation of plans and strategies and with the implementation of systems into their own programs.

During the past six years I have been deeply involved in both the computerization effort at the UCLA Graduate School of Management as well as in surveying and visiting business schools across the country.[1] My visits to schools were focused on speaking with those involved in and responsible for the microcomputerization process in order to identify factors they felt important in their effort. This work is an attempt to synthesize these experiences.

This paper is organized in two parts. The first part describes strategies schools seem to follow in their microcomputerization effort and the lessons and issues which have subsequently emerged. The second part is a case study of the microcomputerization experience at the UCLA Graduate School of Management. Although unique in some respects, this experience has significant similarities to events at other institutions.

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[1] Jason L. Frand and Francis Bertram, "Software Trends and Issues in Business School Computing," UCLA Information Systems Working Paper #6-82, June 1982; Jason L. Frand, *First Annual Computing Survey of North American Business Schools,* UCLA Graduate School of Management, Los Angeles, 1984; Jason L. Frand and Ephraim L. McLean, *Second Annual UCLA Survey of Business School Computer Usage,* UCLA Graduate School of Management, Los Angeles, 1985; Jason L. Frand and Ephraim R. McLean, "Summary of the Second Annual UCLA Survey of Business School Computer Usage," *Communication of the ACM*, Vol. 29, No. 1, January 1986, pp. 12-18; Jason L. Frand and Terance J. Wolfe, "A Framework for the Study of the Computerization of Business Schools: A Preliminary Report," UCLA Information Systems Working Paper #6-86, January 1986; Jason L. Frand, "Introduction of a Micro-Software Standard for Curriculum Development and Instruction at the UCLA Graduate School of Management: A Case Study," Proceedings of the Second Annual Educators' and Trainers' Conference at DATACOM, St. Louis; March, 1987 (forthcoming).

1 Strategies for Introducing Microcomputers into the Curriculum

Based on my visits to the various business schools around the country it appears that schools are following one of four general strategies in their initial computerization efforts. These strategies are listed in Table 1. No one model is right or wrong,

Table 1
Microcomputerization Strategies

- Saturation Model
- Selective Model
- Individual Supportive Model
- Departmental Supportive Model

nor better or worse than another. Furthermore, these models are not pure. No schools adhere 100% to a particular model. Rather, the models seem to describe the general approach schools are taking in their attempts to introduce microcomputers into their curricula.

Attempts to determine why a specific school is following a particular model have met with little success. It can only be conjectured at this point that a mix of administrative leadership style, school culture, availability of financial resources, and/or the stimulus of a computer vendor, among other factors, influence the direction a school moves.

- **Saturation Model**

  Every faculty member and student is expected to make extensive use of a microcomputer system. To implement this approach, the school is rigorously supporting the development of computer assignments for every amenable course. Schools selecting this model have sufficient resources available to provide faculty with machines, curriculum development support, and/or release time. Furthermore, curriculum innovation involving computers may be weighted more heavily in tenure and promotion decisions, or restricted to senior faculty. The model also requires that the school have many student micro systems available or a student population affluent enough to purchase equipment without major hardship.

- **Selective Model**

A specific course or a specific instructor is selected to be responsible for the microcomputerization effort. Schools might choose this approach because faculty as a whole are very research-oriented and the institution does not put a high value on curriculum development; or the school has a very limited amount of money available for buying hardware or for distributing it to students or faculty; or the school is not sure of how to proceed, so assigns the responsibility to one person. One or two individuals are thus responsible for developing a microcomputer course that provides students with the bulk of exposure to this technology.

- **Individual Supportive Model**

In this approach, the school takes a *laissez-faire* posture. Faculty may use computers in courses if they wish, but there is no organized effort, emphasis or pressure to do so. The school may provide some resources to those taking an initiative but it does not create a formal structure for coordinated curriculum development. Schools using this strategy often lack a clear set of overall goals and objectives. There may be a computer lab which is part of the broader campus effort, but it is not an integral part of the school's resources.

- **Departmental Supportive Model**

This approach shifts the responsibility of integration to departments and asks the departments to submit plans to compete for resources. By having groups compete for resources rather than individuals, the departments make a commitment and areas of expertise are built across the group. By allowing the department to make the decision to take responsibility for curriculum development, a school can eliminate some of the pressure on junior faculty, emphasizing that curriculum development is now becoming an "area" responsibility, not an individual's responsibility. Schools following this approach are prepared to provide hardware and possibly other forms of support to faculty in the integration effort.

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The difference between the individual and departmental supportive models can be clarified by the following example. One may think of core courses as "belonging" to departments while electives "belong" to individual faculty members. A school which wants computer integration into its core classes is following the departmental supportive model.

2 General Lessons

Every school is different and thus the factors which lead to success or failure will be different. However, there are five general lessons which have been identified by those actively involved in the effort for the past few years. These lessons are listed in Table 2 and discussed below.

Table 2

General Lessons for Microcomputerization

- Academic Leadership
- Faculty Comfort with Computers
- "Real" Cost of Computerization
- Rate of Computerization
- "Age Myth"

Academic Leadership

Schools have an organizational culture which predates the introduction of microcomputers, and within the cultures there are very definite subcultures. As the introduction of computers requires adaptation and change, the culture and history of the school will influence the attitudes of the faculty and how the school's computerization effort evolves.

In light of these cultural factors, a strong academic administrative leader is necessary to guide the process and to act as the final decision making authority. As the decision making process is drawn out, it is essential that there be one, strong faculty administrator or dean with academic credentials willing to negotiate controversial decisions and have the authority to decide among competing programs requiring resources. This faculty-administrator must be in a position to handle complaints and resolve differences between faculty or curriculum areas while at the same time providing an equitable, strategic view of the implementation process. It is critical that this person have an internalized sense of where the process is going and feels personally committed to a set of goals and objectives so as to defend and speak for the computerization process. An administrator who sees the process as a bureaucratic pushing of papers becomes an impediment rather than a successful organizing spirit.

Finally, the academic administrator responsible for the integrating process must remember that most faculty have many things on their mind – only one of which might be the computerization process. Adapting to various personalities and backgrounds must be seen as a critical prerequisite for success.

Faculty Comfort with Computers

Before a faculty member will use a computer, especially in an instructional setting, he or she must feel comfortable with the hardware and software. It is unrealistic to expect instructors to see new applications and means of interpreting concepts with the help of computers before they are able to use the systems. Thus, adequate and relatively private access to systems, along with training and support, are necessary conditions for computers to be integrated into the curriculum. Based on the distribution of these systems and earlier experiences with computer terminal rooms, a critical lesson emerged: a necessary condition for curriculum integration (and hence, growth in student use of computers), is faculty use of systems as a normal part of their academic life (i.e., in their research). With convenient access, computers become research productivity tools for the faculty members, their usage overflows into classroom examples, and curriculum integration follows.

"Real" Cost of Computerization

Computerization is an expensive process. "Wooed" by vendor offers of substantial hardware and software discounts or gifts, it is easy to overlook the cost of supporting these resources. Large acquisitions of equipment (purchased or donated) necessitate the creation of new jobs (system managers, programmers and operators; communications and software specialists; technical and user consultants), installation of new technologies (networking and telecommunications), preparation of new or expanded facilities (room modifications, furniture and security), as well as the costs of equipment maintenance, software licenses, and data acquisition. All these costs are in addition to costs related to curriculum integration (courseware development assistance, faculty summer support or release time). There may also be a discrepancy between the software offered and that desired by faculty, leading to more unexpected purchase decisions. As a rule of thumb, for ongoing operations support, 25% - 50% of the list hardware dollar value needs to be allocated annually. This estimate does not include equipment replacement costs, which adds on an additional 15% - 20% annually.

Another major cost is that of training. Sending individuals to a course on a particular package or system is extremely expensive both in terms of tuition and time away from the job. Bringing professional trainers to campus can be equally expensive. The development of an internal training program, usually involving student trainers, teaching assistants, is also very expensive and sometimes produces inferior results. The cost of software can easily be dwarfed by the cost of training, which must be considered in calculating the investment in computerization. Training costs become even more critical whenever a change in software occurs, and these costs, both in terms of time and money, can become a major source of resistance to change.

User time is a major hidden cost associated with the computerization effort. The cost of initial training for faculty and students can be measured, but the hours users spend on their own, often frustrated and unable to make progress, is significant. This learning "expense" is a real factor for most people. If individuals cannot take the time to learn to use the hardware and software, the funds for the system may have been used more productively elsewhere.

- **Rate of Computerization**

Going slowly in the decision-making process can be very beneficial. It takes time for change to take place. It is important not to set expectations so high that users are disappointed and/or angry when everything isn't in place and running quickly. Everything takes significantly more time than expected.

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Equipment doesn't get delivered on time, facilities are not completed on schedule, software isn't learned as fast as anticipated, and curriculum materials don't get developed as fast as planned. All of these delays are *not* a sign of problems or failure, but reality injected into the hopes and desires of those that want to see the process occur overnight.

On the other hand, once equipment begins to arrive, it is critical to provide fast responses to problems — a hot line for faculty, walk-in consultants, and lab support.

With respect to introducing computers into the curriculum, impatience may lead to costly mistakes. If a curriculum project fails, it is significantly harder to try it again. Thus, "going slow" with curriculum integration may be the fastest route in the long run.

- **"Age-Myth"**

The belief that younger faculty produce courseware is a myth; older faculty producing courseware is a reality. While junior faculty may be more computer proficient when they arrive, the pressure to perform academically mitigates their ability to put time and effort into the design and development of computer-based instructional materials. Senior faculty on the other hand, who are no longer affected by pressures of promotion and tenure, often have time to develop innovative classroom applications. Frequently, they are motivated by a genuine interest in revitalizing their standard courses, and, additionally, may welcome the opportunity to rejuvenate their own lives.

3 Issues Related to Microcomputerization

Lack of funds and a shortage of space plague every educational institution. Even if these perennial problems could be solved, this would not resolve many of the challenges facing the integration of the use of computers into the curriculum. Many issues were identified which must be considered as schools proceed with the introduction of hardware and the revision of their curriculums to integrate computers. Not every issue is of equal importance at each school. However, based on the interviews and survey which have been conducted, it appears administrators and faculty members at all schools involved with the widespread introduction of computers must be aware of these issues.

The issues have been categorized into three groups:

- *strategic*: issues most closely related to policy and funding decisions,
- *operational*: issues related to selection, implementation and management of the school's computing resources, and
- *instructional*: issues directly related to the integration of computers into the curriculum.

A. Strategic Issues

Six issues emerged which deans and other strategic decision makers must face as their schools proceed with the microcomputerization effort. These are listed in Table 3 and discussed below.

Table 3

Strategic Issues

- Lack of Goals
- Evaluation
- Incentives and Rewards
- Management Leadership
- Campus Relationships
- Funding Sources

• Lack of Goals

The computerization of business schools is often occurring independently of a clear statement of goals and objectives. What is it we really want to achieve as a result of the computerization effort? Why are we making the tremendous investment in this technology? What are the expected benefits? Are there alternatives which are more cost effective? What is the role of computer technology with respect to achieving other goals of the school? Where does information technology fit into the overall scheme of things?

There appears to be a general and widespread *belief* that there will be an increase in personal productivity of faculty and students, and that microcomputers will serve as a valuable research tool and contribute to the learning process. There are many anecdotal accounts to support these beliefs.

The failure of schools to establish clear goals has many potentially negative consequences. There is a saying: "If you don't know where you're going, any path will do." Without clear objectives, opportunities to gain resources or support are made more difficult. Faculty are left to set their own priorities, which, in the long run, may not be most beneficial to the school. For the most part, the overall computerization effort has been hardware driven, with initial faculty attention focused on equipment, not the benefits nor the software or resources necessary to achieve the expected benefits. Many faculty have been motivated by anticipated personal productivity gains through word processing.

The establishment of a set of goals which include the role of information technology should be the first priority in a school.

Some schools have computerization goals, yet actual developments may or may not be related. Many decisions are made as circumstances present themselves which make previously untenable options possible. For example, vendors are approaching major business schools and offering hardware, software, and consulting support — frequently on-site and related to technological and courseware developments. In the face of such opportunities, deans and other decision-makers sometimes find it difficult to resist, and may fail to consider whether the opportunity is linked to their strategic goals.

Evaluation

Closely related to the issues of lack of goals is evaluation. Although it is highly important, no one wants to pay attention to it. We may consider the evaluation issues from five perspectives. First, *why* do an evaluation? For what purpose? Is it an attempt to assess progress toward our goals? Is it to provide a vendor or donor a report on the use of their equipment or software? Is it to assess the processes being used? The purpose of the evaluation must be clear to be able to interpret the results and make the outcome meaningful, and actually proceed with the evaluation.

Who do we go to for the information and *what* do we ask? Without goals we have no idea of what to evaluate. And, even if we establish goals, what criteria are used to measure our success? For example, computer integration is frequently indicated as a goal. What does integration mean? Does simply having computer assignments for a class constitute integration? And who do we ask about the value of these assignments, faculty and/or students?

Fourth, *how* do we gather the information? Do we circulate questionnaires, conduct interviews, review syllabi, collect assignments, or observe student classes? How much time should be invested? Ideally it would be a combination of these techniques, but the expertise to select and design instruments for the use of these techniques may not be readily available.

Finally, *when* should the evaluation be conducted? Conducting an evaluation shortly after (say within the first year or two) of the introduction of equipment may be too early to say whether any real long term gains — either in curriculum or personal productivity and quality output — have materialized. Making the evaluation of the microcomputerization effort a formal part of the planning and ongoing process is the ideal approach, but requires significant time and effort on the part of those involved.

Answering these questions may assist in a *quantitative* assessment of the impact of computers. However, an assessment of the *qualitative impact* of the technology may be even more difficult, as there is no way of knowing the long term effects of use of the various systems on the careers or personal life orientations of faculty or students.

Incentives and Rewards

Within the research-oriented environment of most universities, there are few rational faculty incentives for curriculum development. However, the expectation is that given an environment rich in human resources, curriculum integration will occur spontaneously. Curriculum integration requires a restructuring of the incentive and reward system, and possibly even the curriculum itself. Software and courseware development are very time and effort intensive. Faculty promotion and tenure decisions are usually based on published research in refereed journals, and those who invest their time in courseware development, though possible contributing to the pedagogy of management education, may jeopardize their careers and personal advancement within the system.

• Management Leadership

As discussed earlier, the attitudes and opinions of the dean's office are instrumental to microcomputer decisions. The level of a dean's involvement is determined, in part, by her/his vision of the role of microcomputers in management education, vis-a-vis competition with other business schools, and the perceived benefits of developing and nurturing strategic vendor relations.

Besides the dean's expressed interest, a day-to-day manager of the process is needed. Someone must be responsible for guiding the development of a computer plan for the school, particularly the goals and objectives, strategies and tactics. Someone must meet and confer with faculty to identify needs, educate and set expectations, and manage the introduction of equipment. Someone must supervise technical and user support staff.

But, who will manage this process? Mini and/or mainframe computing services organizations within business schools have traditionally reported to the administrative dean. However, the introduction of microcomputers to faculty in large numbers, as well as advances in the development of instructional support materials, has shifted operational responsibility to the academic administrator. New, as well as re-allocation of existing, resources are required, and faculty are directly involved at an operational level. Who will assume leadership for this venture? Does the dean shift priorities or reassign computing responsibility to an academic dean, department chairman, faculty member, or professional manager?

• Campus Relationships

The relationships between business schools and central campus computing organizations are being redefined. Business school computing activities have become more autonomous as a result of the growth of their own systems. However, these developments are not occuring independently of campus initiatives. Campus-wide organizations still provide large scale computing. In addition, and perhaps more importantly, they are fulfilling key roles in new technological services such as microcomputer information centers, software site licenses and acquisition assistance, training support, consulting, as well as networking and telecommunications.

- **Funding Sources**

Funds for the microcomputerization effort are a major problem. The computerization effort requires *new* sources of funds which the school may not wish to divert from other established projects. Even if equipment is donated, ongoing costs are significant. Decisions must be made whether funds are spent on faculty, secretarial support, facilities and other competing priorities within the school.

Some schools are addressing this need by instituting student computer lab fees. There seems to be two approaches: a general usage fee or a per course fee. The general usage fee is generally used in schools which are following the saturation or departmental supportive models while the per course approach is being used by the schools following the selective or individual supportive model. Schools which have introduced fees using either approach have reported that student expectations for service have been raised and that the fees are often insufficient to cover all cost of computing.

B. Operational Issues

Five major operational issues which have emerged during the microcomputerization process are listed in Table 4.

Table 4

Operational Issues

- Short-term Planning
- Role of Mainframes
- Equipment Obsolescence and Maintenance
- Staffing
- Budgetary Process

- **Short-term Planning**

Business schools have a short-term planning horizon for computing. Limited resources, combined with rapid changes in technology and the computer industry, as well as the day-to-day demands of offering and maintaining user-oriented computing services, make it difficult to plan beyond the immediate future. Schools do not have strategies for dealing with technological obsolescence as new generations of hardware and software are introduced on the market.

One manifestation of the short-term planning is hardware compromises and trade-offs. As schools attempt to make microcomputers available to faculty, students, and staff, they may select computer vendors based on criteria other than pure technical assessments of the product's ability to satisfy the school's requirements. Other factors weigh heavily. These may include, among others, hardware availability, software and technical support, and the vendor's willingness to make a deal that will simultaneously provide the school with the *volume* of hardware it wants and give the vendor visibility (what some have referred to as the "development of a *strategic* relationship"). Schools that opt for a low volume of a preferred product must develop allocation mechanisms for the distribution of scarce hardware resources to faculty and students.

- **Role of Mainframes**

As network technology advances we are able to link our micros and mini and mainframe systems. But, what is the role for these larger systems in this networked environment? The question might also be reversed: "What is the role of the microcomputer?" "Why all the fuss?" Isn't networking micros really an attempt to re-establish time-sharing environments with shared resources?

Even with the increase in microcomputer power and availability, it appears that mini and mainframe computers will continue to play a valuable research, instructional and administrative function. There will always be a need for large databases, numerically intense statistical and mathematical program analysis, and for a system to serve as a communications gateway to other departments, libraries, and institutions. Even though traditional mainframe packages, such as SAS, are migrating to micros, the speed and extent of this transition is not yet clear. There may be some psychological resistance, especially on the part of older "number-crunching" faculty who have worked on these minis and mainframes machines for years, and who have considerable investments in their familiar processes.

The reader should note that this paper is focusing on *academic* rather than *administrative* computing. A continuing, and perhaps growing, role for mini and mainframe systems may be to support the school's administrative information and data processing needs. In fact, as all users (academic and administrative) become more sophisticated, the pressure to support even more applications increases tremendously, thus creating explicit academic versus administrative support trade-offs.

• Equipment Obsolescence and Maintenance

At the time a school acquires equipment, it is usually "state-of-the-art." However, newer equipment, possibly more appropriate for the business school environment, is very likely to emerge in two to four years. What do we do with our existing equipment? Do we upgrade faculty systems and/or student systems? Can we afford the retraining, software compatability, and operating systems change-over costs?

Assuming that upgrading and replacement is necessary over time, what strategy should be used? Should schools establish special replacement accounts into which a sum is placed each year in anticipation of future equipment opportunities? Should a phased replacement policy be established, each year upgrading some percent of the total equipment? Should schools solicit vendor support to have an established upgrade plan as part of their introduction of equipment?

With respect to maintenance, experience has shown us that if hardware is going to fail, it usually occurs either right after installation or after a year or two. Newly acquired equipment is under warranty, but what should be done after the warranty expires? Service agreements average $40 per month per system. Do we take out costly service agreements or wait until something fails and then pay time and materials? If a school or university has a large number of systems, should they begin their own inhouse repair service?

To make the decision regarding an in-house repair service, a school needs to weigh the total external cost of repair against the cost of running a repair

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operation. The critical number in the assessment is the ratio of machines to personnel, with estimates ranging from 400 to 1000 micro systems per service personnel.

On the other hand, in many cases it simply may be cheaper and easier to throw away a broken or defective piece of equipment and replace it, rather than to repair it.

- **Staffing**

A major operational problem is finding and retaining competent technical support personnel. In the early stages of microcomputerization when most users are learning, experienced student consultants may be adequate. However, there are three major drawbacks in student staffs. First, with 50% or more student consultants graduating each year, the process of recruiting and training is extremely expensive and time consuming. Second, as faculty become more sophisticated and knowledgeable users, their needs change from wanting a quick response to a simple question to wanting quality explanations of the source of the problem. These more sophisticated and knowledgeable users are inclined to want a more thorough analysis of the problem source so that they can make corrections themselves the next time. Student staff tend not to have the skills to provide this higher level of service. Third, faculty want to develop a rapport with the provider of the service so that they can call that same person over time.

The alternative to students is a professional staff. This too, however, has its problems. For example, when the UCLA Graduate School of Management was given funds to hire new technical support personnel, extensive advertisements for experienced computer professionals to provide expertise in communications, microcomputers, and system operations were placed in the local newspapers and several national computer journals. These brought in approximately a half-dozen qualified applications, individuals who appeared to have both the technical and the social skills necessary to communicate with faculty and students. Unfortunately, those most desirable commanded salaries that were beyond the School's financial means. These individuals already had salaries in the mid-to-high forties and expected the same or higher salary, beyond the guidelines used by the University. Thus, the School turned to a slower approach of internally developing its own expertise by upgrading the skills of its current professional staff. This may have short term drawbacks (i.e., problems arising from the lack of experience), but may develop long term loyalties and a tailored staff.

- **Budgetary Process**

Creating a budget which reflects the *real* costs of computing is a difficult process. It is difficult to find assistance or guidelines because so few people have ever been through the experience. There is simply a plethora of questions for which answers are evasive. What are the appropriate categories and how much should be allocated to each? What is required for specific tasks, equipment, etc.? Should we plan for permanent staff or count on student assistance, and at what levels? How much will site preparation and furniture cost? How much should be budgeted for contingencies, the unexpected problem or the new opportunities which will inevitably present themselves?

There is a "common" set of budgetary items such as staff, facilities, software which need to be addressed. With permission of the Dean's office, the UCLA Graduate School of Management computing budget for the 1985 and 1986 fiscal years, and the projected budgets for 1987 and 1988, are presented in Appendix A. In this budget, a zero in a location indicates that $0 were spent, while a blank indicates that the amount is unknown. The budget does *not* reflect the acquisition of approximately 2.5 million dollars in hardware between 1982 and 1985. The reader may find that the budget has greater significance in interpretation after reading the case material presented in Part II of this monograph.

C. Instructional Issues

A major goal of the microcomputerization effort has been the integration of computers into the curriculum. This goal is more elusive than many anticipated. For example, the current curriculum structure and organization may require major revision to accommodate integration. Class time may need to be lengthened or units adjusted or additional lab sessions added. "Retrofitting" computers into a full schedule does not necessarily enhance the teaching or learning environment.

By *curriculum integration* we mean trying to do more than replace a calculator with a computer or introducing computers into courses for which there was no

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previous use. Integration occurs when the computer is used to introduce concepts and provide insights previously difficult or impractical to achieve. Based on our experiences and discussions with numerous faculty, the following list of issues related to curriculum integration, summarized in Table 5, has emerged. This list is

Table 5

Instructional Issues

- Selection of Courses to be "Integrated"
- Faculty Responsibility
- Teaching Style and Motivation
- Equipment Barriers
- Courseware and Software Constraints
- Lack of Data
- Courseware Development Support
- Student In-class Use of Computers

not comprehensive and the categories are not mutually exclusive.

• Selection of Courses to be "Integrated"

There is no question that some classes lend themselves more readily to computer integration than others. And yet, even in these cases, there are some faculty who justifiably feel the course emphasis should minimize the use of computers. Who is to decide which classes should be computerized? Some schools have a strong tradition of allowing individuals to teach "their" course, and instructors are free to select the content, text, assignments, and examination procedures. Should this orientation be changed if the use of computers is not part of a particular instructor's interests or view of the material? Who should make these decisions and based on what criteria?

Parallel to the question of "which courses?" is the question of "how much per course?" It is not clear what constitutes an integrated course. To what extent must a computer be utilized to say that the course is integrated? Various scenarios are possible. One is where an instructor uses a computer during lecture to demonstrate a concept, or several concepts at various times through the term. Another is where computers are not used in the classrooms but students are given assignments which require computer analysis, (e.g., one short assignment, one major project, or several assignments of varying length). Or both faculty demonstrations and student assignments may be used. Clearly there is no single approach. Curriculum integration is completely content and/or faculty dependent.

- **Faculty Responsibility**

Faculty are responsible for overall curriculum development, but responsibilities for research will often preclude their spending extensive amounts of time on courseware development. Experiences at schools involved in courseware development suggest that developing computer-based demonstrations and assignments is very time consuming. An individual may spend many hours per student contact hour in preparation. If the materials are of the interactive analysis type, where students sit at a micro and work their way through the courseware, faculty members and courseware developers have reported spending 30 to 60 hours per contact hour when working with an established software package. Furthermore, they have reported spending 100 to 300 hours of development for each hour of self-contained material when the development includes design and programming. Authoring languages may help, but it is not clear how or to what extent. Thus, the question of "Who is responsible for courseware development?" must be addressed.

The computer must be seen as supporting instructional objectives. Courses should not become lessons in the operation of computer applications. Frequently, difficult choices must be made regarding which topics to include or exclude, and faculty are responsible for teaching the concepts of an area in the limited time available in a course. So, with the introduction of computers into a course, what material will be dropped from the course? When will the use of the computer system, the software, and the courseware itself, be taught, and by whom?

• Teaching Style and Motivation

When thinking about the widespread introduction of computers into courses, the teaching style of a faculty member must also be considered. It is quite possible that some very effective teachers would be less effective using a computer because their intuitive styles did not adapt well to the use of a computer. Furthermore, instructors who have above average teaching evaluations have little motivation to change. Not only must they address the out-of-class issues already discussed, they must face the prospects of a lower rating if things don't go well.

Faculty need to understand the motivation behind the use of courseware and must believe that it is an important and valuable component of the educational process. Faculty attitude, positive and negative, is very contagious. If a professor just brings floppies into a classroom, throws them on a table, indicates that he just got them, hasn't looked at them, and the students can use them if they want, the material will probably get minimal use.

Furthermore, in the selection of materials, the faculty members must feel some sense of ownership or they probably won't use them. They want to select the material and not have someone else tell them what to use or do. They don't like to be presented with a final product — a packaged course. Thus, with courseware there is a potential "catch-22" — faculty will use materials only if they participate in the development or selection, but they may not do so because of the various barriers.

• Equipment Barriers

Faculty will only use equipment such as overheads, videos, or computers in their classes if they perceive it will make their job easier or student learning better at an acceptable cost. If it's a hassle, they won't use it. Along this line is the lack of classroom projection systems which enable students to view the analysis the faculty wants utilized. If a professor chooses to use courseware as part of a lecture, the equipment to run and display the material should be readily accessible in the classroom. If it is necessary for a faculty member to wheel in two or three carts with projectors, monitors, and micros, the courseware will receive little use. The equipment should either become a fixture within the classroom or personnel should be available to set up and test the equipment for faculty before they need to use it.

- **Courseware and Software Constraints**

A broad array of courseware materials simply don't exist. And, if they did, who should pay for them? Should the school be responsible for providing the materials to the faculty? Schools don't provide textbooks or other materials. Furthermore, evaluating the prospective courseware entails learning the structure of the package as well as how to use the materials. Finally, once a decision is made regarding a package, assignments must be created, and then a way to distribute the materials (copying diskettes, providing copies to library, etc.) must be found. Currently, the obstacles to courseware are such that few instructors are able to implement its use.

Additionally, courseware use is inhibited by software inflexibility. Faculty see a textbook as a random access utility in which they can move about easily, selecting chapters in any order they choose or omitting chapters at their discretion. At the same time, the student can access the material skipped without difficulty. Software, on the other hand, doesn't have that intrinsic property, and, with floppy diskette systems, moving about a system may be very confusing. Spontaneous classroom elaboration may be constrained by predefined examples and a program's limitations.

- **Lack of Data**

The ultimate constraint on the success of curriculum integration efforts may be the lack of data. Even if the right software package is available, it may be difficult to find the right data to analyze which will fully illustrate the concepts and challenge the students. As our systems become more sophisticated, we will want to do more "realistic" analyses, which in turn, require more realistic data. One solution may be to have a real corporate database with financial, marketing, production, accounting, etc. data online. However, there are several obstacles to this approach. Acquisition of corporate data may be difficult, and if acquired, modifying it to support instructional objectives, extracting that data appropriate to the separate courses, may be even more difficult. An alternative is to use commercial databases, such as COMPUSTAT (financial statements) and CRSP (stock market data). These, however, require very significant storage capacity (400-500 megabytes) and a mainframe system for support, in addition to site licenses of several thousand dollars per year.

This bottleneck will be relieved somewhat by similar databases such as Compact Disclosure and ONE SOURCE from Lotus, which are being distributed on compact discs, and run on a microcomputer. But once again, the cost of these databases is several thousand dollars a year.

Other possible data sources are the online data services available by telephone hookup, such as COMPUSERVE and LEXUS. Unfortunately, these services are very expensive, usually with a per minute access charge, and require telecommunications equipment to be made available to a large number of students.

The short term alternative to these large databases is smaller datasets tied to the specific case material the student is using.

• Courseware Development Support

Faculty express genuine concern about their role in the curriculum integration process. On the one hand, they would like to see better utilization of computer-based applications, in particular micro-based applications, in the educational process. On the other hand, they don't see it as their responsibility to teach computer skills such as how to use micros or various software packages. To the extent that computer applications facilitate the teaching of *concepts* rather than *skills*, faculty seem to be supportive of "courseware" development. Faculty want to know that students have the requisite skills so that their efforts can be concentrated on concepts and applications.

In light of the issues discussed above, what type of support should be provided to faculty so that a school can achieve some degree of computer integration throughout its curriculum? Given the current state of courseware availability and quality, it is not realistic to expect faculty to "go it alone."

One approach is to consider courseware acquisition and development as a team effort. One such team might consist of a faculty member, a curriculum development specialist, and a programmer. The faculty member would be the "content specialist", responsible for identifying the instructional objectives and the specific goals to be achieved. After the courseware was identified and available in the form to be used by the instructor, the faculty member would review the materials to insure accuracy and instructional validity. The curriculum development specialist would identify potential packages which could meet the objectives stated by the professor. If software needed to be developed, the specialist would provide information on program design and user interface issues, and would serve as the project coordinator to supervise and guide the development effort. The curriculum development specialist should have a background primarily in pedagogical concepts and secondarily in the content area of the field for which the courseware was being sought or developed. This person would also be responsible for maintaining professional standards in interface design, programming style and documentation. The programmer would implement the courseware design as specified by the faculty member and curriculum development specialist, and could be a student in the area.

- **Student In-Class Use of Computers**

  If courseware is used with instruction and if equipment is available for use outside of class, then the evaluation procedures may need to be modified so that students can use the computer on their examinations. If they don't, then students may choose to use calculators in their homework. On the other hand, if students bring micro systems to their exams, they could easily have entire sections of text available "online" to use during the exam. Some instructors do not like to give "open book" exams. Could this be monitored? Should restrictions on use of systems be imposed because it creates unfair advantage for those with systems, or those who can afford "better" systems?

  There are other complications. If students bring non-portable systems to class, there may be insufficient electrical outlets and power to support them. And, what if a system "goes down" in the middle of class? Also, printers need to be conveniently located for producing output.

4 Summary

The past several years have seen a significant growth in the number of business schools which are introducing microcomputers into their curriculum. These schools seem to be following one of four paths: saturating the school, selecting specific individuals for penetration, focusing on departments, or taking a laissez-faire position and allowing development to occur wherever there is an interest. Irrespective of the approach, those schools which have moved ahead have learned from their suc-

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cesses and failures. These lessons include the need faculty have to be comfortable with computers before they work their way into the classroom, the significant and real costs of computerization, that going slow in decision-making and curriculum integration and very fast in responding to problems may be optimal, that a strong academic leader is essential for success, and that senior faculty may be more likely to do curriculum development than junior, non-tenured, faculty.

Strategic, operational, and instructional issues have also emerged for which answers, and in many cases, even appropriate alternatives, elude us. The strategic issues include the lack of goals and evaluation alternatives, faculty incentives and rewards, management leadership, changing campus relationships, and finding new funding sources. Operational issues include the lack of long-term planning, the changing role of mainframes with introduction of networks, dealing with equipment obsolescences and maintenance, finding and retaining competent staff, and managing the computer related budget. Finally, there are the instructional issues which relate to the selection of courses to be integrated, faculty responsibility, teaching style and motivation, barriers to using equipment and courseware including materials, textbooks, software, data, and in-class support equipment.

A major challenge for the next few years will be to bring together the people and resources to bring to fruition the promise of the technology which now is, and will becom , more available. Part of this challenge will be to remain flexible enough to respond to technological innovations and opportunties as they arise. Identifying our goals — how we want our schools to look in the future — is a critical step in meeting this challenge.

In Part II of this paper, an indepth study of one school's experiences with the microcomputerization process, is presented.

Part II: A Case Study of the UCLA Graduate School of Management

During the past five years the use of computers at the Graduate School of Management (GSM) has grown exponentially. Even though computers have been available and used as an important computational tool for the past thirty years, their impact has only now become pervasive. Faculty and students alike turn to the computer as a support tool; almost 100% of the students and 75% of the faculty use computers regularly. The opportunity for this growth was made possible as a result of various equipment grants. Given this opportunity, GSM faculty and staff have worked toward the successful implementation and thorough penetration of the technology into all aspects of the program. This case study summarizes many of GSM's successes and problems, and GSM's plans for the future.

In Fall, 1984, GSM began introducing microcomputers throughout the School. The previous three years had been spent planning and writing proposals — and the past two years trying to learn, live with, and accommodate the new technology. This six year period 1981-86 is the primary focus of this case study.

We begin with a historical review of the computer planning process at GSM and a discussion of the social-technical environment — a look at the shifts in values and attitudes which have occurred. The study continues with a discussion of the resource allocation scheme which emerged and a description of three major curriculum experiments. Next, a general assessment of the impact of the technology is presented. The case study closes with a glimpse into the future — GSM in 1990 — what may evolve from our investment in information technology.

GSM has approximately 80 permanent faculty, 850 MBA and 125 Ph.D. students, and a two year Executive MBA program with 110 students. Computers have been used at GSM for approximately 30 years. Prior to 1982, computing at GSM was mainframe-oriented, using the central campus systems with access via punched cards and hard copy terminals. Users were charged for system access, and such funds were always at a premium. Beginning in 1982, GSM received the first of a series of major equipment grants, acquiring its own Hewlett-Packard 3000 minicomputer which provided non-recharge interactive access. In the Fall of 1984, GSM provided HP150 microcomputers to one-third of the faculty and established a microcomputer laboratory for the students. In the Summer of 1985, half of the GSM faculty received an HP110 lap-top microcomputer and during 1985-86, most of the remaining GSM faculty were provided with IBM desktop microcomputers and the student lab expanded from 20 to 60 systems. Thus, the *microcomputerization* of the School was well underway. Some of these major computing events at GSM during the past thirty years are summarized in Table 6. The extensive hardware growth during the past five years is summarized in Table 7.

Commensurate with this hardware growth has been GSM's financial commitment to computerization. During the past two years GSM has been trying to clearly identify all of its computing expenses — a most arduous task under the best of circumstances. With permission of the Dean's office, the GSM Computing Budget for 1985 and 1986 fiscal years, and the projected budgets for 1987 and 1988, are presented in Appendix A. The budget includes current operating support for the approximately 2.5 million dollars in hardware and software acquired from its grant efforts between 1982 and 1986.

The budget in Appendix A is organized as follows: the first column is the item category; the next two are a listing of the actual 1985 and 1986 fiscal year expenditures and acquisitions; and the last two columns on the right, the projected budgets for the current year, fiscal 1987, and next year, fiscal 1988.

The budget items have been organized into the following categories. The first part presents a summary of all of GSM's computing resources including both donations and support expenses. For example, for fiscal year 1986, GSM computing resources were $2,523,000. The next three sections are the source values for this summary table, specifying the list value of the hardware and software acquired from each of our grants, the expense categories in support of these grants, and the source of funds to cover the expenses.

The reader may find that the budget has greater significance in interpretation after reading the case material.

1 The Decision Process

The physical introduction of microcomputers to GSM began in September 1984. For the previous three years, however, a major organizational effort contributed toward the creation of a computerization plan. Since 1981, GSM had submitted several grant proposals in support of its instructional program to various computer vendors. The process of developing these proposals forced GSM to address the role

Table 6

COMPUTING EVENTS AT GSM

1957...	Western Data Processing Center established at GSM; statistical and mathematical programming conducted in batch mode.
Circa 1967	Merger of GSM computing with engineering to form central campus system with GSM as a node; first of several generations of IBM mainframes.
Circa 1971	GSM led in the introduction of interactive end-user-oriented computing using APL and hard copy terminal.
Circa 1980	Text editing type word processing access to IBM 3030 mainframe; 12 coax cables installed over the next couple of years connecting faculty offices to the IBM mainframe; key punch replaced by terminals for mainframe access.
Spring 1982	HP3000 Series 44 with 15 interactive terminals installed at GSM; most MBA student use shifted to HP3000, with word processing as the principal application.
Fall 1984	55 HP150 microcomputers (30 to faculty, 25 to students) installed; HP3000 upgraded; Lotus and dBASE introduced in a few classes; "Micro-supported Case Analysis" experiment with second year students enrolled in Management Strategy and Policy course (Mgmt 420); faculty offices wired to HP3000.
Summer 1985	70 HP110s lap-top portable computers given to faculty; "Lap-top Computer" experiment with 55 HP110s distributed to the entering students in the Executive MBA program for use while in the program.
Fall 1985	40 HP Vectras (32 to faculty) and 60 IBM micros distributed to faculty; Advance Development Center opened with 6 IBM micros; IBM 3090 installed as central campus system.
Winter 1985	Selection of WordPerfect as the word processing standard for administrative support; GSM disk on campus IBM 3090 providing online access to CRSP and COMPUSTAT financial databases.
Spring 1986	Ashton-Tate pilot program: Framework II adopted as software standard for instructional program; AT&T data switch installed linking faculty offices to both the IBM 3090 and HP3000.
Summer 1986	30 IBM PC/ATs installed in student lab; 55 HP110 Plus lap-top systems distributed to the entering Executive MBA class.
Fall 1986	"Physical Science Model" experiment, a required hands-on lab for first year students enrolled in Managerial Computing course, Mgmt 404.

Table 7
GSM Hardware Growth

	SEP 1982	SEP 1984	SEP 1985	SEP 1986
MINIS	1 HP3000/44 with 2Mb	1 HP3000/68 with 5Mb	1 HP3000/68 with 5Mb	1 HP3000/70 with 10Mb
DISCS	2 HP7925 Disc Drive (240MB)	1 HP7925 Disc Drive (120MB) 3 HP7933 Disc Drive (1.2GB)	1 HP7925 Disc Drive (120MB) 3 HP7933 Disc Drive (1.2GB)	3 HP7925 Disc Drive (360MB) 3 HP7933 Disc Drive (1.2GB) 1 HP7933XP Disc Drive (404MB)
TAPES	1 HP7970 Tape Drive (1600 BPI)	1 HP7978 Tape Drive (1600 BPI)	1 HP7978 Tape Drive (6250 BPI)	1 HP7978 Tape Drive (6250 BPI)
TERMINALS	15 HP2622A CRT 1 HP2635B Console 3 HP2641A CRT 1 NEC Spinwriter	15 HP2622A CRT 3 HP2641A CRT 1 HP2647F Console	15 HP2622A CRT 2 HP2627A CRT 3 HP2641A CRT 1 HP2647F Console	15 HP2622A CRT 2 HP2627A CRT 3 HP2641A CRT 1 HP2647F Console
MICROS		150 HP110 Portable PC 55 HP150 PC 2 HP150/B PC 1 IBM PC/XT	190 HP110 Portable PC 55 HP150/C PC 2 HP150/B PC 40 HP VECTRA 60 IBM PC/AT 1 IBM PC/XT	210 HP110 PC Portable 57 HP150 PC 72 HP Vectra 25 IBM PC Portable 14 IBM PC/XT 158 IBM PC/AT
PRINTERS	1 HP2608A LP 1 HP2601A Daisy	1 HP2608A LP 1 HP2601A Daisy 2 HP2563A Printer 5 HP2934A Dot Printer	1 HP2608A LP 1 HP2601A Daisy 2 HP2563A Printer 5 HP2934A Dot Printer 10 HP2686A LaserJet 1 HP2688A Laser Printer	1 HP2608A LP 1 HP2601A Daisy 4 HP2563A Printer 18 HP2686A LaserJet 1 HP2688A Laser Printer 5 HP2934A Dot Printer 23 IBM QuietWriter 54 IBM ProPrinter
PLOTTERS	1 HP7221C 8-pen	1 HP7221C 8-pen 5 HP7475A 6-pen	1 HP7221C 8-pen 5 HP7475A 6-pen 2 HP7550A 8-pen	1 HP7221C 8-pen 5 HP7475A 6-pen 2 HP7550A 8-pen
COMMUNICATIONS	5 Prentice 1200 Baud	8 Prentice 1200 Baud	8 Prentice 1200 Baud	1 AT&T Information Systems Network 1 IBM LAN for 80 PC's 8 Prentice 1200 Baud 2 ARK 24K Modem
OTHER			1 HP46087A Digitizer	1 HP18173A Protocol Analyzer 1 HP46087A Digitizer

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and priority of computing within the School. As a state-funded school with limited discretionary resources, GSM saw the donations of hardware and software as a major source of support, but with real dollar costs associated with operations and staff. Thus, the proposal opportunities provided the motivation for developing plans and setting priorities. GSM addressed these issues through a committee structure.

The Planning Committees

During the 1981-82 academic year the Computer Planning Committee drafted a long-range computer plan for GSM which addressed the broad instructional, research and administrative needs of the School. One of the key aspects of this plan was the ready availability of equipment, specifically microcomputers, for faculty and student use. To both acquire this equipment and develop staff resources, the planning committee called for the active pursuit of funds and hardware through purchase discounts or vendor donations.

The 1982-83 Computer Committee discussed the new microcomputer technology and its role in management education. As a result of these discussions, two School-wide goals emerged: computer literacy for all GSM faculty and students and the thorough integration of computers into the MBA curriculum. By *thorough integration* we mean doing more than replacing a calculator with a computer, and introducing computers into courses where there was no previous use. Integration occurs when the computer is used to introduce concepts and provide insights previously difficult or impractical to achieve. These goals reflected the growing role and importance of computers in general, and the increasingly significant impact of microcomputers in particular, on the modern management environment.

During 1983-84, three committees addressed curriculum and implementation issues. An MBA Curriculum Task Force was charged with reviewing and recommending changes to the entire MBA curriculum. A major portion of its report focused on the role of computers. This committee recommended that a computer orientation program be developed for entering students prior to the start of the academic year. It also reviewed the curricula and syllabi of all core MBA courses in an attempt to identify those aspects most amenable to computerization.

Two other committees also investigated the role of computing within the School. In recognition of the interdependent roles of research and instruction in a contemporary program of management education, the Research and Computing Committees were charged with jointly addressing implementation issues such as resource distribution to faculty and students, software acquisition and/or development, hardware compatibility, and space and facility requirements. Through numerous sessions, an allocation scheme emerged and equipment distribution priorities were established. Two proposals to vendors emerged from these various committees. Each was successful: one was part of a campus-wide grant awarded to UCLA by IBM, while the other gained additional equipment from the Hewlett-Packard Company.

In Spring, 1984, a new Computing Policy Committee was appointed. While previous computer committees were dominated by those with a strong interest in or knowledge about computers, the new committee consisted of the chairpersons from ten of the major curriculum areas of the School, as well as two additional Computers and Information Systems faculty. (The associate dean/department chairman[2] and I were *ex officio*.) The Committee was charged with recommending resource allocations and software standards which would impact all areas of the School. (The hardware allocation process is discussed in Section 3 below.)

In Winter, 1985, the Committee approached the issue of software standards by assigning committee members responsibility for different software applications: one each for word processing, spreadsheets, database, graphics, communications, statistics, general modeling packages, and utilities. These individuals were to survey opinions and make recommendations regarding specific packages. Although these areas were identified, the focus during 1984-85 continued to be on acquisition of hardware. Software was to wait a year, at which time the Computer Policy Committee tackled the problem of software standards for both academic support (research) and instruction.

In Summer, 1985, based on the successful introduction of the microcomputers during the previous year, the Committee modified one of the strategic computing goals and added a third. The strategic goal of computer *literacy* was redefined to one of computer *proficiency* to reflect the changing nature of training and support services required by faculty and students. The new strategic goal was "to expand the use of computer modeling and simulation techniques where appropriate in the curriculum." This new goal reflected the growing awareness of the power of spreadsheet and linear programming packages. Although this goal may be seen as

[2]GSM is a one-department school and the roles of the department chairman and associate dean for academic affairs are combined.

a subset of the second goal (thorough integration), it was added to call particular attention to modeling techniques. GSM's strategic instructional computing goals are listed in Table 8.

Table 8
GSM Strategic Instructional Computing Goals

- Computer proficiency for all GSM faculty and students.
- Thorough integration of computer topics and usage into the MBA curriculum.
- Expanded use of computer modeling and simulation techniques.

One of the major benefits of having three different committees, each comprised of 7 to 10 members, was that approximately one-third of the tenured faculty of the School were involved in discussions related to the implementation and use of microcomputers in the curriculum. This broad involvement was part of an educational effort to make faculty aware of the various issues surrounding the use of computers.

Word Processing Standard for Academic Support

Although GSM has a very long history of computer use, software standards were never an issue. Individuals programed in the language they chose, using key punch machines until online systems were available, and then whatever editors were available on the system. Generally users had minimal control over software selection decisions. With the introduction of "personal" computers, however, users gained control over software and could choose what seemed most appropriate to them, using a multiplicity of criteria. With this freedom the software standards issue emerged.

Along with the HP150 microcomputer systems donated to GSM in Fall 1984, one copy each of Lotus 1-2-3 and Wordstar was provided for every two systems. However, Wordstar was not well received. GSM attempted to obtain a site license or special purchase arrangement with Lotus Corporation, but failed. Hence, even though these software packages were the "first in the door," they were not universally used.

Support of faculty word processing emerged as the first area where the software incompatibility became a School-wide concern. With the number of faculty members with microcomputer systems in their offices and/or at home increasing rapidly, and with systems being installed in secretarial areas, the question of which word processing package would be generally supported became critical. Thus, in November 1985, a "word processing" assessment was conducted by the Computer Policy Committee. This process consisted of reviewing the various journal articles, obtaining evaluations of different word processing packages, and speaking with individuals about their needs and what they were currently using. In the course of the word processing assessment, it was suggested that an integrated package which would support word processing as well as other common functions such as spreadsheets and database applications be considered. The argument in favor of a broad integrated package was that it would meet many different needs without the need to acquire and learn new systems for each application. In an integrated package, the user only needed to learn one interface, one file system, and one set of functions.

From the pool of possible packages, three emerged for standards consideration: one word processing package (Word Perfect) and two integrated packages (Framework II and Enable). A software demonstration was arranged and representatives from each company were invited to GSM. Word Perfect was then selected as the official word processing package for academic support. Secretaries were trained on Word Perfect and consulting made available to them. Faculty members who chose to use another package and wanted secretarial support were responsible for making whatever adjustments and modifications were necessary to import and export the files to a Word Perfect format.

Although both Framework II and Enable were found to have significant breadth of application, the primary concern was a high quality word processing package which secretaries would be able to master and use extensively with the mix of equipment available. Although both have now been enhanced, at the time of the decision in December 1985, neither integrated package had word processing capability which matched the power of Word Perfect.

Instructional Software

The objective at GSM is not to teach software or a particular package, but rather to focus on management concepts and issues and use the software to assist students in concept understanding and application. However, it was recognized that if we wanted students to know software, for at least the next couple of years, the School had a responsibility to teach it. Furthermore, the feeling was that the selected software should be educationally sound, and also have a viable commercial following.

The Computer Policy Committee identified seven application areas in which software for curriculum development and instruction seemed appropriate. These are listed in Table 9.

Table 9

Student Software Requirements

- Word Processing
- Modeling tools (including spreadsheets)
- Statistical tools
- Graphics (business and presentation)
- Database
- Idea processing (outlining)
- Communication (file transfer)

The general concensus was that although no one package could do all of these functions, an integrated software package would meet most of the typical MBA student's computing needs. The advantage of such a package would enable GSM to use its limited resources to support one system with one vendor rather than incur the costs of training students, supporting multiple packages, and dealing with multiple vendors.

As part of the debate, the question of requiring students to own a microcomputer was raised and rejected. Some other schools (most notably Harvard in 1984 and Wharton and Chicago in 1986) were strongly recommending or requiring student hardware acquisition. However, the general feeling at GSM was that the *courseware*, (defined as the software, data, and procedures to achieve a specific instructional objective), justifying such a move was simply not available. However, the School was responsible for providing adequate hardware in support of the instructional program. Thus it was appropriate to focus on a software standard to guide faculty in courseware development and students in selecting and learning a package.

Another point discussed was current software acquisition and distribution policies. Some software had been obtained from our grants, but both the number and selection were limited; for example, the School could obtain only IBM logo software via the IBM grant. To meet our software needs, other software had to be purchased. Software was distributed to students in the management library using the same procedures as for book check outs. However, problems of lost, stolen, and damaged diskettes made this less than an optimal alternative. Hard disk network versions of the software as well as the networks themselves for the distribution were not yet available. Thus, in the discussion of software it was felt that the students should become responsible for obtaining and monitoring their own software, and that they could use generic systems to do their analyses. GSM's responsibility was to provide the hardware, training, and support that would enable the students to complete their assignments.

Selection of Framework II

The formal adoption of Framework II by the GSM faculty as the integrated instructional standard occurred in June 1986. There were three simultaneous events which led to this decision. First, one of GSM's senior and well-respected management science faculty members (also area chairman and hence on the Computer Policy Committee) had been using Framework II extensively in his research for almost two years and strongly recommended its adoption as the academic support and instructional standard. He argued that Lotus 1-2-3 (for spreadsheet) and Lindo (for linear programming would always be needed and used), but that Framework II would meet at least 75% of the software needs of most GSM faculty and students.

Second, in December 1985, GSM was contacted by a senior manager from Ashton-Tate, the developers of dBase and Framework software. He indicated that Ashton-Tate was interested in discussing the possibility of a "strategic relationship" with the School. A series of meetings were held during the winter and spring of 1986, which provided opportunities for GSM to present its computing goals and plans, and for Ashton-Tate to explore ways in which to work with GSM for mutual benefits. The dialogue led to an agreement between GSM and Ashton-Tate whereby Ashton-Tate would provide assistance to the School in the form of software, discounts, training, and support, and GSM would provide Ashton-Tate the opportunity to meet and discuss on a formal and informal basis with our faculty and students to obtain information regarding business and management uses of their software. GSM also agreed that anyone obtaining Framework II under the agreement would receive at least a two hour introductory training session.

Third, parallel to the discussions with Ashton-Tate, the Computer Policy Committee began debating the acquisition of an instructional software standard. There was concern that we had adopted Word Perfect for word processing and that to select another package for students would put an unfair and unnecessary burden on the faculty to learn yet another package. Also, Lotus 1-2-3 was the standard spreadsheet in the corporate world and it would be to our students' advantage to learn it. On the other hand, if Word Perfect and Lotus 1-2-3 were adopted, given the University purchase agreements and lack of site licenses, the cost of one copy of each of the packages would exceed $400, and there would still be the need for additional packages. The unanimous agreement was that an integrated package such as Framework II appeared to be adequate for the typical student's basic requirements outside of the more advanced statistical and mathematical modeling requirements. Furthermore, it was not GSM's responsibility to teach a particular package, but rather the concepts underlying generic systems. The students could make the transfer to other packages when appropriate.

As a compromise position, the Computer Policy Committee recommended the adoption of Framework II as the integrated software standard for instruction for a one year trial period. Other software such as Lotus 1-2-3 would still be used if more appropriate, or if cases or material were readily available in that format. But for material developed within the School and for the training provided to our entering MBA students, Framework II would be used for the next year.

In June 1986, a faculty meeting was called to discuss the recommendation. The overall response was positive and supportive. However, a few faculty who had invested considerable time in both learning Lotus 1-2-3 and developing instructional materials with it felt they could not afford the time to re-invest in Framework II. It was decided that the Framework II approach was not to be seen as excluding other packages if they were more appropriate, and some assistance with conversion to Framework II would be available if there was an interest.

Following the Framework II decision, the faculty teaching statistics courses at GSM decided that a single package would also facilitate their program. Hence, in Summer, 1986, SAS/PC was selected and installed on approximately 40 hard disk microcomputer systems.

2 The Social-Technical Environment

Table 6 presented a summary sketch of major computing events at GSM during the past 30 years. This long association with computing created an organizational culture and a set of values, expectations and attributes which were influential in the microcomputer decisions.

During the three years prior to the introduction of the microcomputers in Fall, 1984, major changes in attitudes and values occurred. In this section we will review some of these changes from five perspectives: that of the School's administration, the faculty, the operational personnel, the students, and the central campus administration.

GSM Administrative Perspective

During the 1981-83 time frame, it was clear that the Dean's office was supportive of the early growth of computing, but the extent to which the administration was committed, or understood the scope, breadth and depth of the computerization program, was not clear. The initial equipment grant proposal submitted in 1981 to the Hewlett-Packard Company was the result of contacts by the Associate Dean for Administration.

In Fall, 1983, a new chairman/associate dean was appointed. He felt that the microcomputerization effort was one of the most critical and important events in recent GSM history, and hence, set out to better educate himself on the issues and alternatives and became an active member of the Computer Policy Committee. He was involved both in formulating and carrying out policies and discussing the use of the systems. With the large scale introduction of systems looming on the horizon and faculty demand for such systems becoming more vociferous, the active participation of the Dean's office became a critical link between the implementation effort and the realities of available resources.

The active involvement and support of both the Dean and the Associate Dean has been and continues to be a critical element in GSM's ability to achieve its strategic computing goals. The Dean's office has conducted extensive public relations efforts with both Hewlett-Packard and IBM, as well as influencing the direction of the grant proposals.

Faculty Perspective

Most GSM faculty have, at one time or another, used computers to support their research effort with major focus being on mathematical modeling and statistical analysis. Approximately 50% currently use the campus IBM mainframe, although research support dollars for computing have almost always been insufficient to meet the demand. [3] On the other hand, many faculty members were dubious about the use of computers based on prior disappointing and frustrating experiences dealing with the centralized campus facilities: difficulty of use and limited access methods (primarily batch processing), inadequate administrative and staff support, and changes of mainframe operating systems. These attitudes had to be changed and, in fact, these faculty needed to be "won over" if the School's computing goals were to be achieved.

Unfortunately, the initial equipment grant of a minicomputer and 15 terminals did not help to alleviate these feelings. The grant supported the instructional program and specified that the equipment was to be used by the students. Thus, all the terminals were located in a public location with common access for both students and faculty. In this environment, only a few faculty members developed programs and assignments for their classes. These faculty were primarily already regular computer users and for whom statistical and linear program packages were readily available. For the most part, the faculty viewed the new minicomputer in the same way as the central campus mainframe, rather than as a new opportunity to change their own work or their instructional approaches.

It was difficult for faculty who were not already computer literate to have an opportunity to use the system in an atmosphere closely related to their normal work environment. Coming to the computer center for an occasional workshop or

[3] UCLA uses a recharge system with a portion of the funds provided annually by the Vice Chancellor for Research Programs and the remainder provided by research contracted funds.

demonstration showed the potential power of the system, but without being able to spend time alone, reflecting and exploring the system, nor able to use it easily and regularly to directly support their general needs, most faculty simply didn't use the computers.

In light of these faculty attitudes and the restrictions of the initial minicomputer grant, all efforts were focused on involving students with the use of the system. Faculty who were interested in transferring their work from the mainframe to the minicomputer were encouraged and supported.

Parallel to these developments was a drive for greater microcomputer involvement from a few key faculty in the curriculum areas of Management Science, Marketing, and Computers and Information Systems. These faculty members were extremely anxious to see GSM introduce microcomputers throughout the School, and provided leadership and guidance to their colleagues by sharing insights and ideas which helped to shape GSM's plans. They argued that for faculty to develop instructional materials they needed to use the equipment as part of their regular set of tools, that they had to become comfortable before significant progress could be made. Furthermore, there had to be sufficient equipment close to faculty offices so that they could use the system to meet research as well as instructional objectives. As outlined earlier, the various computing committees involved a large, broad segment of faculty and encouraged members to return and discuss the various options with their colleagues [illegible] his played an important role in helping to enlighten, change attitudes, and esta[illegible] base of values geared toward the computerization effort.

There was a new element in all of this — the personal computer. The emerging plans indicated that faculty members would be responsible for and have access to equipment which they could control themselves, without competing with colleagues or students, or depending on a central computing facility. Given this new atmosphere, faculty appeared more willing to listen and more open to trying a variety of new options. There were also social forces — media advertisements being aired and general "computerese" becoming prevalent — creating a bandwagon effect and broadening the base of support.

Operational Perspective

A third perspective on the computerization process involved operational personnel — the Computing Services support group. In July, 1980, I was appointed director of GSM Computing Services.[4] At that time, Computing Services consisted of a key-entry operator and two FTE of student personnel used as programming consultants. Two programming languages, APL and PL/1, were taught and the the statistical package SPSS was widely used. Computing Services support staff were technically-oriented students proficient in these languages. All computing during this period was on the central campus IBM 3033 mainframe with access via punched cards and hard copy printing terminals.

When I became Director, the role of Computing Services was changed from that of a reactive, technical programming group to a proactive, multifaceted organization interacting with all aspects of the computerization effort. This included development of the School's computing plan as well as development of space and facility plans, general coordination of the incoming systems, and planning the training and support options to be offered to both faculty and students. Computing Services became an instructional support unit of the School, responsible for offering consulting assistance to students enrolled in courses in which computers were used as well as providing learning experiences to students with no previous computing background who wanted to enter the field. It should be noted that although during this period Computing Services reported to the Associate Dean for Administrative Affairs, it was charged with only supporting GSM's academic program. During 1983-84 a re-organization took place and Computing Services now reports to the Associate Dean for Academic Affairs.

With the introduction of the HP3000 in Spring, 1982, the Computing Services staff grew. A computer system/user services manager was hired, the key-entry position was upgraded to an administrative assistant, and student personnel were increased to three FTE. Besides the HP3000, Computing Services had the ongoing responsibility for providing programming consulting for the IBM 3033 users. This period was the beginning of the shift of almost all student computing to the HP3000 and reserving the IBM 3033 for faculty and doctoral students.

During the subsequent year, it became evident that a significantly larger com-

[4] I had joined the GSM faculty in March, 1979, as a lecturer in statistics and mathematics. I have continued to teach two or three course per year while serving as director, and in Spring, 1985, was promoted to an Adjunct Assistant Professor in Computers and Information Systems.

puter staff would be necessary to successfully implement the computerization effort. Thus, a plan for increasing the computer staff was submitted to the Dean's office and was wholeheartedly supported. The Dean's office then presented the plan to the Chancellor's office for approval and funding. This effort was successful and in Fall, 1984, Computing Services staff was expanded to four FTE for career positions and seven FTE for student support personnel.

A measure of the student's perspective of the role of computing in the School can be derived by comparing the number of student applicants for positions in Computing Services in 1980 with those in 1983. In 1980, approximately 20 students applied for positions while in 1983, over 75 students applied. Currently, approximately 80 students per year have the opportunity to gain direct computer-oriented experience from a "provider" rather than "user" perspective.

During the Summer, 1982, an entering MBA student came seeking employment. When told no funds were available, she said she would like to work simply for the experience. From this modest beginning a full-fledged volunteer program emerged. Currently, Computing Services receives approximately 40 applications per quarter for 20 volunteer openings. Paid student support is now drawn directly from the volunteer pool. The volunteer experience trains and orients new students, while providing an evaluation period to assess the volunteers ability to contribute to the program. Paid computer consultants work 10 to 20 hours per week while volunteers work 5 hours per week (2 hours training and 3 hours as assistant consultants on duty the same time as a regular consultant). All computer support staff wear bright orange vests so that users can spot them in the crowded labs.

Student Perspective

Prior to the introduction of the School's minicomputer in Spring, 1982, student computing on the campus mainframe was restricted to class assignments (usually programming or statistical analysis) and to use in masters and doctoral research projects. There were approximately 200 active MBA student accounts on the IBM mainframe. In Spring, 1982, with the availability of the HP3000, an entirely new computing era began. Not only was an "open access" machine available for student use, but also new functions such as word processing and interactive statistical analysis became available. Within two years of the introduction of the School's minicomputer, the number of active MBA student accounts increased to almost

500.

The students were extremely supportive of the computerization effort as evidenced by their queuing up to use whatever equipment and facilities were available. They signed-up for terminal access one, and sometimes two, days in advance. The graduating class of 1982 purchased a letter-quality printer as its class gift so that students would have the advantage of high quality output. Students constantly raised questions about the availability of more equipment. They attended workshops on the use of the equipment and software regardless of whether the workshops were directly tied to specific class assignments.

Student demand for increased computer support came mainly in the form of questions and complaints: "Why do we have to wait so long to get on the system?" "When are we getting more equipment?" "Why aren't their more workshops?" "Why can't we do more graphics?" "Shouldn't we have Lotus 1-2-3?" "When will we have microcomputers to work with?"

Campus Perspective

Between 1981 and 1984, the UCLA administration's attitude with respect to computing underwent some major changes. In 1981, computing was seen only as a mainframe activity. By 1984, campus administration was advocating "coordinated" decentralization and allocating resources in support of this effort. In large part, this change was due to the proliferation of minicomputers and the potential introduction of microcomputers, combined with a major report prepared by the Academic Senate calling for a reorganization of campus computing. In Spring, 1982, the Chancellor appointed an Academic Computing Committee charged with recommending a computing plan for the next five years. The committee met twice a month for fifteen months and completed its report in Summer, 1983. There were two major outcomes of this committee report. First, it established the ground work for a successful campus proposal to IBM for a major equipment grant. The grant, obtained in May 1984, provided over 1000 IBM PCs to the campus, with approximately 100 for GSM. These systems were installed at GSM beginning in Fall, 1985.

The second major outcome was the appointment of an Academic Computing Council consisting of several deans and other university administrators. The council was appointed by and charged with advising the Vice Chancellor for Research

Programs (responsible for academic computing at UCLA) on issues related to the IBM grant. Each school or college at UCLA was to submit a computing plan specifying instructional and research objectives, equipment requirements, support dollars needed and the source of these dollars. Following negotiations between the campus administration and the relevant dean for operational funds to support computerization efforts, the Academic Computing Council reviewed the school's or college's equipment requirements and recommended the allocation of equipment from the IBM grant.

3 Hardware Allocation Process

Through its own grant proposal efforts, GSM obtained 55 Hewlett-Packard 150 microcomputers which were installed in Fall, 1984. Prior to the actual delivery of this equipment, discussions focused on whether GSM should accept non-IBM compatible micros. Specifically, the concern was related to software acquisition. However, the two packages initially seen as most important were Lotus 1-2-3 for spreadsheet analysis and a word processing package. Lotus and Wordstar, the popular choices at the time, were available for the HP150. Most computer language compilers were also available. With the software impediments rationalized, the HP150s became an important element in the microcomputerization effort.

Since GSM has approximately 100 faculty and 1000 students, the more difficult question was: How should the equipment be divided between faculty and students? This decision had to be made in an environment characterized by the provision of only 55 available machines, a rapidly growing student demand, and a more interested and motivated faculty.

Allocation Objectives

Since this was GSM's second major equipment grant from Hewlett-Packard (the first being the HP3000 minicomputer system), we wanted to benefit from our first experience. In the first grant, Hewlett-Packard specified the grant was to support instruction and wanted all equipment available to students. However, the restriction on distributing equipment to faculty was counterproductive. The lack of access to the system limited faculty development of assignments requiring educational use of the system. Thus, students increasingly used the system for word processing support, with 80% - 90% of its use at any given time being word processing. We wanted to avoid a repeat of this situation with the introduction of the micros.

The introduction of microcomputers also presented entirely new opportunities for instructional development. Realizing the key to this success was through direct faculty involvement, we argued that the best way to increase meaningful academic student use of computers (i.e., beyond just word processing) was to increase faculty knowledge about and skills with computers, and to change attitudes towards the usefulness of computers as an instructional tool. Furthermore, this could be achieved more effectively through faculty use of the equipment in what was important to them, namely research, and in an atmosphere in which the computer was a natural part of their work environment, preferably in their offices. With this approach, we predicted we would have more student assignments requiring computing. This has proved to be generally accurate. In light of the experience with the minicomputer terminals, we requested that approximately half of the new microcomputers be allocated to faculty and half to students.

Allocation Scheme

Knowing that a portion of the equipment was destined for faculty did not end the dilemma. Meeting after meeting discussed the equipment allocation issue. Should the equipment go to common areas or be given to individuals for use in their offices? Should allocation be based on individual faculty proposals to develop curriculum? How should the IBM equipment obtained from the campus-wide grant and coming the following year (i.e., Fall, 1985) be handled? Should faculty who received HP equipment be able to switch to IBM equipment at a later date? In the majority of cases, it was the most innovative faculty who were anxious to get equipment first, and who would thereafter want the latest, best and most advanced equipment. The decision was to give faculty the option for replacements as additional equipment became available.

Once the equipment was allocated to faculty, how should they be supported? What types of support would be necessary? What kinds of workshops? What kinds of training? These and other allocation questions were battered about in hallways as well as in committee meetings.

From these encounters an idea emerged that rather than supplying individuals with equipment, entire curriculum areas should compete for it. Also funds should be provided to hire a doctoral student from each area who would be trained in the use of the equipment and could support the area's implementation effort. This student would be able to work on curriculum, faculty training and tutorials, and provide opportunities for area support. Furthermore, it was thought that providing equipment to academic areas rather than individuals would create a sense of synergy; the equipment would penetrate an entire curriculum area rather than a single class. The idea thus presented the opportunity not only for greater faculty education, but also motivated curriculum penetration.

Allocation of Resources

The allocation question then became very specific: Which of GSM's eleven curriculum areas would receive computers? Some of the areas had faculty who were active on the various committees and they indicated their interest in the HP equipment. Some areas were indifferent, while still others were strongly committed to IBM and wanted to wait until those microcomputers arrived. Thus, the consensus of the faculty was that five areas would receive the initial HP150 systems: Management Science, Marketing, Production and Operations Management, Accounting Information Systems, and Organizational and Strategic Studies.

In September, 1984, each of these areas received approximately five microcomputers and a quarter-time student assistant known as an Area Computing Consultant (ACC). The ACCs were assigned to help support the overall introduction of equipment and to train and support the area faculty. Although each of these areas had more than five faculty members, the area chairperson and faculty drew up a list of those individuals who seemed most likely to use the equipment and benefit from its ready availability. Within the areas, specific efforts were undertaken to develop faculty literacy and competence as well as alerting the faculty to potential classroom possibilities. Faculty members were encouraged to ask the ACCs for assistance as needed. In becoming comfortable with the equipment and using it for research, we expected faculty members would began to see spinoffs for use with their students.

During Spring, 1985, GSM submitted its master plan for computing to the campus-wide Academic Computing Council discussed above requesting equipment for faculty during 1985-86 and for student laboratories in 1986-87. This equipment would be from the campus-wide grant. The plan included course integration proposals, budget projections, and an allocation mechanism which specified that an equipment budget would be allocated to each curriculum area proportional to the number of ladder faculty and each area. Each area would then allocate resources to its faculty and decide whether each member got equal funding or if the area would pool resources to account for differences in individual needs and the benefits of resource sharing within the area (e.g., print and file servers).

The plan also indicated that the School would be standardizing on IBM PC/AT or AT compatible microcomputer systems. This decision followed from many discussions after the PC/AT introduction in Fall, 1984. The reason for the PC/AT standard was that, even though we would get fewer systems, they would provide the technological base needed to enable GSM to meet its needs through the end of the decade. This decision gained further support in August, 1985, when Hewlett Packard introduced its AT compatible system, the HP Vectra. Thus, through the combination of grants, GSM obtained sufficient equipment to meet its initial needs.

During the 1985-86 academic year, GSM received approximately 80 IBM PC/ATs and 40 HP Vectras. Twenty Vectra's were installed in a student lab and the remaining systems were distributed to faculty members. Some areas chose to have HP equipment and some elected to go with IBM. This widespread distribution of equipment prompted the selection of Word Perfect as the word processing standard as discussed previously.

In Spring, 1985, GSM was awarded one of the thirteen IBM Management of Information Systems business school grants. This grant provided each school with up to $1 million in hardware and $1 million cash. The cash contribution by IBM reflects the corporation's deep understanding of and appreciation for the schools' need for resources which will enable the grant equipment to be more effectively used and objectives more readily achieved. GSM is using its hardware grant to acquire additional desk-top microcomputer systems for its general student lab, a few very sophisticated powerful systems for an advanced development lab for students specializing in Computers and Information Systems, as well as a 2.5 gigabyte (2.5 billion bytes) disk pack to be installed on the central campus mainframe and to be used to store the large databases used by GSM. The cash is being used for faculty and staff support. (See budget items in Appendix A for more detail.)

During Spring and Summer, 1986, space was identified and preparation of an additional student laboratory was begun. There was a considerable amount of discussion over tables, chairs, lights, air conditioning, and power requirements, as we wanted to take advantage of what we had learned from our experience with the initial labs to make the new lab a better facility. In Fall, 1986, student systems arrived (before the physical lab was ready) and the new lab came online in November, 1986. A fourth (and final) student laboratory is due to come online in February, 1987.

In summary, as a result of its grant efforts, GSM will have approximately 250 workstations distributed in faculty offices and five student laboratories. Two student labs have Hewlett-Packard equipment: one consists of 30 HP150 microcomputers which also double as terminals to the HP3000, while the other has 30 HP Vectras. The Advance Development Center, consisting of six advanced IBM microcomputer based systems (AT/370, 3270 PC AT/GX, and 4 PC/ATs), and the newest microcomputer lab opened in Fall, 1986. This new lab consists of 30 IBM PC/ATs with a video display system which, when finished this Spring, will enable the instructor to display the output of any workstation to any other workstation, to the entire class, or any combination. Also, cabling for a token ring network has been installed and the ring should become operable as soon as the network hardware arrives. A second lab of 30 IBM PC/AT and video display equipment is scheduled to open by Summer, 1987. All the labs have laser and dot matrix printers and numerous plotters for the preparation of quality presentation graphics.

Evaluation of the Initial Allocation

There were several successful components to our initial scheme for allocating microcomputers to faculty. In retrospect, it did create the opportunity for faculty areas of synergism to develop, and the sharing and assistance amongst these faculty proved very useful in increasing their individual productivity and some new class assignments. But most important, we gained significant experience with the equipment and exposure to some problem areas which we were able to better manage during the widespread introduction of equipment the following year.

However, one major problem was that some faculty received equipment and then didn't use it.[5] During the initial few months (when hardware was still scarce), I met with each faculty member who had received a micro and discussed their individual

[5] It must be noted that, as indicated above, GSM has been fortunate to have received a significant amount of equipment through grants and hence many of the equipment problems were shortlived.

needs and objectives. Based on these interviews it became clear that three faculty members had decided not to invest the time and energy to learn to utilize the computer at that point in time. Even though consultants were available to help, the faculty chose not to take advantage of their services. Since there were requests from other faculty, these systems were reallocated to the Business Economics area, and the faculty who received this equipment became extremely adept developers of Lotus programs for their classes. The lesson we learned was that it is important to be flexible in identifying individual innovators and supplying them with the equipment they need.

With respect to the allocation of hardware to the student labs, it seems that the more equipment made available, the greater the demand. One wonders if the saturation point will be reached only when every student has his/her own system? This is a very positive indication of the overall growth of computers within the School, but a major source of frustration for many students. In response to the student needs, lab hours have been extended — going to full 24 hour availability during the last weeks of the quarter.

Our Area Computing Consultant (ACC) concept initially seemed very fruitful in helping to get equipment set up, but we did not fully utilize these student assistants. Furthermore, management of the ACCs was difficult since they reported to "area faculty" rather than a specific individual who could be held accountable. Being assigned to a whole area rather than an individual, they seemed to slip through the cracks, rather than actively seeking out and developing material. Some faculty used them for research support and not classroom support, or let them just work on their dissertation, not on class material.

Even with these difficulties, the concept of a computer-trained person assigned to an area for faculty support was important enough that plans to expand the program for the 1985-86 academic year were approved. Part of th[illegible] resource was used to set up a faculty "hotline," a special phone number where faculty could call for immediate help, with the remainder allocated to areas which submitted plans to use an ACC. The "hotline" met with mixed success, with the faculty preferring to call our full-time professional HP3000-oriented staff, rather than the student consultants, even though the students at that time, were more knowledgeable about microcomputer hardware and software. By the middle of the year, the hotline was discontinued and the allocation was shifted to developing microcomputer training and workshop materials.

The 1985-86 ACC program was more successful than the previous year, however we found, for both the hotline and ACCs, that we again lacked sufficient management supervision of the students. There were however, three very significant projects completed by the ACCs, two microcomputer based and one mainframe based. For the microcomputers, a set of exercise modules using Lotus 1-2-3 were developed for an economics course and a set of ten laboratory exercises using Framework 1.1 were developed for a computing course.[6] The mainframe project was in the finance area and was made possible by installation of the large 2.5 billion byte disk on the campus computer. Two major databases used by finance faculty, Compustat and CRSP, which have the financial statements of organizations and daily stock returns, respectively, were previously stored on tape and required extensive programming to access. The project involved the installation of these databases on the new disk pack and the creation of a menu-based access program. Our plans are to create a subset of the data to be installed on the School's minicomputer and create programs for student access and downloading of data to microcomputers for analysis.

4 Curriculum Integration

GSM, in accepting the equipment grants, initially from Hewlett-Packard and later from IBM, had agreed to use the equipment to impact the curriculum. This has been an extremely long and arduous process, much more so than many of us anticipated. Although there are numerous examples of individual faculty who developed assignments for their classes, they tended to be in the quantitative areas. There was no guarantee that our stated goal of computer literacy for *all* our students was being achieved.

In this section we relate three experiments designed to more fully impact the curriculum. The first involved the entire second year MBA class — the "Micro-supported Case Analysis" experiment. The second involved the Executive MBA class — the "Lap-Top Computer" experiment. The third is based on a new idea which emerged from these experiences — the "physical science model" for management instruction, which involved the core managerial computing course. The

[6]The ACC involved in these two projects was an MBA student who graduated in June, 1986, and was subsequently hired to fill a new position, Courseware Development Manager. His responsibilities include soliciting faculty courseware proposals and supervising the ACCs to implement these proposals.

section closes with a discussion of student orientation and training workshops, our main effort focused on increasing general computer literacy.

The "Micro-supported Case Analysis" Experiment

During the committee discussions of equipment allocations to faculty, one idea which emerged was to allocate the equipment in such a way that it would affect the maximum number of students. With this in mind, the Organization and Strategic Studies curriculum area became a prime candidate. This group had not previously used computers in its courses. However there was a specific course, Management 420, *Management Strategy and Policy*, required of all second year students and the capstone for the first year MBA core curriculum. Entirely case-oriented with most of the cases lending themselves to "what-if" analysis, this course provided relatively easy and straightforward applications for spreadsheet analysis.

In Spring, 1984, the faculty who would be teaching the seven sections of the course next fall were asked to meet and discuss the possibility of computer support for the course. It was proposed that each of them would receive a microcomputer and the support to create Lotus templates for data analysis. Although there was some skepticism, they agreed to the experiment. One professor served as coordinator and an ACC was assigned to work with the faculty on the course. The coordinating professor polled the other faculty to identify which cases should be prepared. Based on this information, templates with the data and formulas for twenty-three cases were prepared.

The creation of the templates and the inputting of the data turned out to be more difficult than originally anticipated. The microcomputers had 256K of memory, which proved insufficient for many of the cases. There were problems setting up the templates as they predetermined the nature of the analysis and could limit the approaches used by the students. The question of how to distribute the data to the students also needed to be resolved. They would each need their own diskette, but depending on the instructor, they would be using different cases, and hence different data.

The data size and template design problems were resolved by the coordinating professor simply making a decision of how to proceed. The data distribution was handled by storing all the templates on the minicomputer, with students downloading the data to the microcomputers.

At the start of classes in the Fall, the ACC visited each section of Management 420 and explained that the Lotus spreadsheets were prepared to assist them with their case analyses and how to access the files. Numerous Lotus workshops were scheduled to teach the students how to use the package and download the files.

Unfortunately, this course development effort achieved only marginal success. Approximately 20% of the students made use of the programs on a regular basis. There were two main reasons: problems with the equipment and lack of faculty support. Our microcomputers were scheduled to arrive in June but did not arrive until September. This delay prevented the faculty from having sufficient time to learn and become comfortable with Lotus. Additionally, there were communications problems in establishing the link between the microcomputers and the minicomputer for downloading the files which weren't completely resolved until mid-quarter. By this point, many students were already doing their case analyses without using the system, so the time the system was operating consistently, was little motivation to use it. Finally, the computer staff were learning Lotus along with the students in the classes and hence not as able to help them as would have been ideal.

A second, and in many ways a more significant problem, was faculty support. Some of the faculty did not believe this was a valuable tool, and as such, its usefulness was not impressed on the students. In a subsequent evaluation meeting, faculty agreed that the course experience was not all that it could have been, in part because they had not reevaluated the course material in light of the new equipment and opportunities. They simply had not taken the time to do so. One professor argued that the arrangement we used for disseminating the data and having the students work individually on the material assumed that the students could figure out how to do the analysis on their own. Another instructor, soon up for tenure, felt that it took so long to prepare the first time he taught the course, that with a tenure decision so close, he didn't want to again make such a major time commitment. This constant conflict between research, with its incentives for tenure and promotion, and the desire on the part of the School and the sponsoring computer companies to achieve curriculum integration, emerges over and over again.

In retrospect, given the late arrival of the equipment and the training and faculty support concerns, it probably would have been better to delay this integration attempt one year. However, the desire to achieve a major curriculum success made us overly optimistic regarding the difficulties. As a result, we did not achieve our objectives, and even more significantly, one group of faculty was discouraged from trying to use computers in their classes in the near future. On the other hand, we moved along the learning curve as a School.

"Lap-top Portable Computer" Experiment

In June, 1985, HP made a grant of HP110 laptop microcomputers to GSM for use in the Executive MBA program, designed for the full-time senior level manager who wants to return for a rigorous two year MBA, with classes meeting alternate Friday/Saturdays including three one-week live-in sessions.

In August, before classes began, each member of the ExMBA program was issued an HP110 portable computer to be used during their tenure in the program.[7] Entering students, depending on their background, attended either two or six two-hour workshops to familiarize themselves with data processing concepts in general, and the HP110 in particular. Students were shown how to access the HP3000 for the mail system and to use the available software packages. The instructors created assignments which required the use of computers, and for many, this was the HP110. Students brought the systems to class and took notes "online," and some used them during exams. Overall, student acceptance and use was very positive.

There were and are several problems, most relating specifically to the HP110 (e.g., the liquid crystal display being difficult to read, 16 lines too few, and the limited memory often frustrating). There was a need for printers and floppy diskettes. The 300 baud modem was too slow, especially for those making long distance calls into the HP3000 system. It is clear that all these problems will be resolved with more sophisticated technology — HP's upgraded lap portable, the HP110 Plus, overcomes most of these problems. A pedagogical problem was that the instructors could not readily display the individual student's work for full class discussion.

The student evaluation of the lap portable experiment, however, was extremely positive. They felt the systems were an important tool, and most of the students used the portable in their work environment. They saw themselves learning skills with immediate transferability. Based on this success, the lap-top portable computer experiment was expanded and the class entering in Fall 1986 was also

[7] The HP110 is a 256K lap-top computer with an electronic disc, internal modem, and weighing 9 pounds. Lotus 1-2-3, a wordprocessing package, and communications software are ROM-based.

assigned HP110 systems.

"Physical Science Model" for Management Instruction

In light of the previous two experiments, it was agreed that for curriculum integration to succeed, there should be greater faculty involvement and more intensive support for both faculty and students. A teaching assistant, for example, might bring the students into a computer lab and actively conduct analyses. Thus, the students, under the tutelage of a computer lab teaching assistant, could glean the maximum benefit from the process.

This idea emerged as our "physical science model" for computer support of instruction in management education. In the physical sciences, professors lecture in large halls on a topic's background and theory. In assigned lab sessions, students spend two or three hours per week under the direction of a teaching or lab assistant, conducting experiments specifically aimed at illustrating the concepts discussed in the previous lecture. A similar model could be developed for use within the business school environment. Lectures which present general concepts and principles could be followed by specific lab assignments. Under the direction of a teaching assistant, students would use the computer as a laboratory instrument, manipulating data and conducting experiments which might illustrate and highlight the theory presented in class.

The first class at GSM to experiment with the "physical science" model was *Managerial Computing*, Management 404. This core MBA course is taken by approximately two-thirds of our students and has been the "computer literacy" class for years. During the 1970s the course discussed business data processing and focused on APL and PL/I for interactive and batch programming, respectively. In 1982, APL and PL/I were replaced by database and Pascal assignments on the School's new minicomputer. When microcomputers arrived, the course included dBASE II and Lotus assignments. With these changes, more lecture time was spent on business computing and managerial issues and less on the tools. Hence, it seemed very appropriate to try the new instructional model with this course.

During Spring, 1986, the usual four hour lecture class was scheduled as two hours lecture and two hours lab.[8] The lectures were condensed versions of the

[8]This arrangement was used because we wanted to experiment with the model and not have to go through formal procedures for changing course hours and credits.

previous material and the labs used a student version of Framework 1.1 accompanied by an instructional textbook.[9] The overall reaction was quite favorable, and hence the experiment was expanded and tried with all the Management 404 sections during 1986-87 year, with a couple of modifications. First, the lecture time was scheduled as three hours (instead of four) and the lab as two hours (countin two hours of lab as one hour of lecture). Second, the full, complete Framework was used instead of the limited instructional version, and additional material on telecommunications and program development were included. Teaching assistants conduct the lab sessions under the supervision of the instructor. As of this writing (January, 1987), the course is achieving its goals of teaching both concepts managers need to know about computing as well as introducing the end-user managerial skills, tools and concepts.

A second course, *Managerial Finance*, Management 408, is experimenting with the physical science model during Winter, 1987, and another course, *Productions and Operations Management*, Management 410, will be evaluating this approach during the Spring quarter, 1987. For both of these courses, an ACC has been working with the course instructors to identify and develop appropriate lab material. The School as a whole is looking toward these experiments to decide whether lab sessions should be associated with more courses. Alternatively, a single lab with each week's session focusing on a different functional area, required for all students, is being considered. Irrespective of the approach finally selected, the initial view is that there is merit to the physical science model for integrating computers into the management curriculum.

Student Training: Orientation and Workshops

Entering MBA students are required to attend a week long orientation and registration program conducted by the admissions office before the start of fall classes. In order to increase general computer literacy, in 1984. for the first time, the incoming class was taken on a tour of the computing facilities and students signed onto the School's HP3000 system to get access to their accounts. This orientation proved very effective. In the fall of 1985, the entering class had a four hour computer orientation: hands-on sessions on GSM's HP3000, the campus IBM mainframe, and the HP150 and IBM PC microcomputer systems.

[9]Beil, Donald H., *Using Application Software: An Introduction Featuring Framework*, N.Y.: McGraw-Hill, 1986.

To fund the development and teaching of the orientation workshops, the program was offered as a service. Participation was voluntary and those choosing to attend paid a $25 fee. Approximately 300 students (about 75% of the entering class) elected to attend in the fall of 1985. A similar fee arrangement was used for the 1986 workshops and approximately 370 students (92%) elected to attend. The orientation workshop instructors were GSM students who work as Computer Services consultants during the academic year.

Based on an evaluation of the 1985 orientation program and the introduction of Framework II as the instructional standard, a 5-hour computing orientation was developed for the fall of 1986: 1/2 hour overview, 1 hour using the HP3000 system, 1 hour introduction to MS-DOS, and 2 1/2 hours introduction to Framework II. The Framework II sessions focused on introducing the concept of a frame, the menus and application environment (1 hour), with the remainder of the time spent on word processing.

The Fall 1986 computer orientation program represented four major changes from the 1985 program. First, the focus was on software rather than hardware. Second, the IBM mainframe sessions were dropped since by the time students used the mainframe (for some specialized second year courses), they needed another workshop. Third, rather than a lock-step approach, students were able to select the sessions which they felt would be most beneficial. Fourth, the learning style approach was changed from almost 100% tutorial, with each student working from written materials at their own pace with consultants available to assist with problems, to about 50% lecture and 50% tutorial materials.

For the second year MBA students, a three hour introductory Framework II workshop was offered which introduced the frame concept, word processing, and spreadsheets. Significantly different approaches were made for the first and second year student orientations to Framework II, as it was assumed that the second year students had been exposed to word processing and spreadsheet packages during their first year and that there would be concept transfer to Framework II.

Besides the orientation sessions, GSM Computing Services consultants provide about 200 hours of hands-on workshops for GSM students during the academic year. During 1985-86, about half the workshops were microcomputer-oriented and focused on Wordstar, Lotus 1-2-3, and graphics software. The other workshops were HP3000 or IBM mainframe-oriented and concentrated on the use of the editors and statistical and linear programming packages required in various classes. Many of the workshops provided both elementary and advanced sessions. For 1986-87, the plan has been to present a series of "advanced" Framework II workshops as well as continue most of the previous workshops but with fewer sessions offered.

5 Impact of the Microcomputerization Effort

From the perspective of January, 1987, how have we fared during the past five years? Have GSM's three strategic instructional computing goals (listed in Table 8) been achieved? The following three sections revisit these goals. First, however, some caveats. The goals speak in terms of "computer proficiency" and "computer integration." As was discussed in the section on evaluation, no clear definitions or means of assessing proficiency and integration are available. Hence, our evaluation is based on survey, interview, observation, and anecdotal records of what is happening, as well as on material faculty members were asked to prepare as part of an extensive evaluation of the campus-wide computerization effort.

Goal 1: Computer Proficiency

During the past two years, approximately 80 microcomputer workstations have been installed in GSM faculty offices and approximately half the faculty have attended workshops on the use of these systems. A data switch provides faculty access to the campus and school's mainframe systems and electronic mail systems. About one-third of the faculty reported that they make extensive use of the data switch.

We can approach the issue of faculty proficiency in terms of their reported use of computers. Faculty members from all areas of the School report research benefits of having the computer systems available in their offices. This benefit has been expressed in two areas. First, GSM faculty produce a large volume of articles and books and have reported major productivity gains from word processing which eases the task of composition and revision. Second, because of the links to the mainframes, faculty are able to do most of their quantitative research from the peace and quiet of their offices rather than in the noisy and distracting computer rooms. This leads again to greater productivity and better work. Many individual faculty have reported that these two elements have been a tremendous boost to their own productivity, thus leaving valuable time for other responsibilities.

In terms of software, almost all faculty use either Word Perfect or Framework II for word processing. $\TeX$ is popular for typesetting papers. Approximately 30% of the faculty have had PC SAS installed on their systems and use it regularly. Furthermore, many GSM faculty write their own code in support of their research, mainly using Turbo-Pascal or FORTRAN. There is some use of SPSS on the mainframe, but SAS is the more popular, with many individuals reporting transfering files from the IBM 3090 to their micro and using SAS in both locations.

Student proficiency can be inferred from their attendance at workshops and reported use of the various systems. As discussed earlier, 75% and 85% of the 1985 and 1986 entering classes, respectively, attended the voluntary computer orientation programs. A total of 114 workshops were offered during the 1985-86 academic year, with 55% microcomputer-based, 31% on the HP3000, and 14% were on the campus mainframe. Workshop offerings have also been classified by major software categories: spreadsheets (32%), quantitative analysis (25%), word processing (24%), database (14%), and graphics (5%).

A student survey in December, 1985, indicated that GSM students used the computer resources an average of 5.3 hours per week. A similar survey in December, 1986, indicated that usage has increased 25% to 6.6 hours per week. GSM also provided approximately 75 consulting hours per week to the user community. The adoption of Framework II, the installation of additional student facilities, and approximately 90% of the entering MBA class attending the Fall 1986 computer orientation, all indicate that the trend will be toward even greater student use of systems.

The evidence suggests that the first goal, computer proficiency, is nearing reality.

Goal 2: Curriculum Integration

It is extremely difficult to determine the exact *quantitative* impact of computers on the curriculum. Many faculty at GSM give assignments which require data analysis but they do not specify whether the student is to use a calculator, computer, or just pencil and paper. Observations of students working in the computer labs suggest that their use far exceeds the specific course requirements. Recognizing this limitation, GSM has gathered data which suggests the depth of penetration.

At the end of the Spring quarter, 1986, GSM faculty were surveyed to determine

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the courses for which students were required to utilize GSM's computer resources or the central campus computer. Sixty-eight full-time faculty members who received equipment were contacted and 49 responded, a response rate of 72%. Thirty-eight different courses, representing a total of 73 sections, reported required computer assignments. These sections had a total enrollment of 1,967 students. For 27, or 37%, of these sections, the 1985-86 academic year was the first time the computer was used. Most of the responses from faculty indicated that they were very satisfied with the initial use of computers and planned to continue and/or expand their instructional usage. Additionally, the physical science model of using computer labs is being extended as discussed earlier.

The second source of data suggesting that curriculum integration is well underway is from a pair of student surveys. A survey of first year MBA students was conducted in December, 1985, and again in December, 1986, asking students to list the courses in which they used computers. Under the current GSM curriculum program, first year students usually enroll in four of seven courses. Table 10 shows the results of the surveys for these courses. Unfortunately, due to sampling constraints, the data may not represent a true random sample of the GSM student population. However, it is considered adequate for identifying trends.

Table 10
Student Use of Computing
in First Year Core MBA Courses

	Fall 85	Fall 86	
Surveyed/Enrolled (percentage)	219/372 (59%)	247/402 (61%)	
Computer usage by course	%	%	% change
402 Data Analysis	23	56	+143
403 Accounting	25	13	- 52
404 Computing	100	100	0
406 Economics	100	100	0
407 Modeling	71	90	+ 27
411 Marketing	50	77	+ 54
440 Problem Solving	50	50	0

From the data presented in Table 10, a general trend is that the use of computers is on the increase. Specifically, for two courses, *Managerial Computing* and *Managerial Economics*, computer use has been required for at least the past two years. However, there has been significant increases in the use of computers in the *Managerial Data Analysis*, *Managerial Modeling*, and *Managerial Marketing* courses. No change was shown in the *Managerial Problem Solving* course. The decrease in student computer usage in the *Managerial Accounting* course is explainable in terms of the faculty who taught the course this year and last year. Seven sections of the course were offered both years and the one professor who encouraged computer usage taught two sections in 1985 and only one section in 1986.

As promising as the data in Table 10 appears to be, GSM expects to make even greater gains this next year as many of the technical and equipment barriers, and issues related to curriculum integration, are overcome.

Goal 3: Expanded Use of Modeling and Simulations

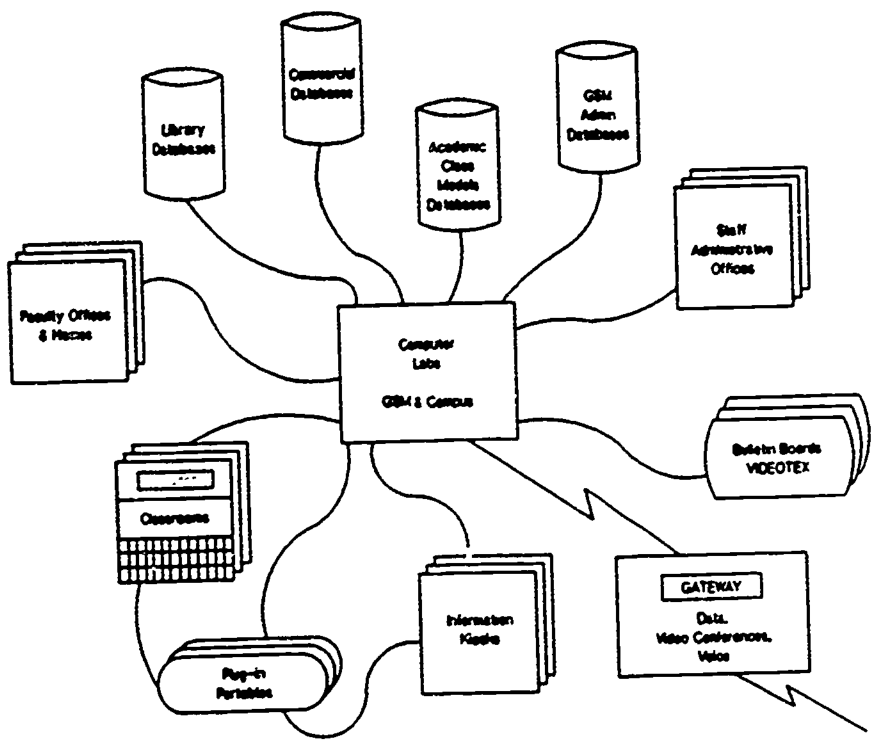
Faculty reports of their specific projects indicate that our goal of expanding the use of computer modeling and simulations is being achieved. There were many successful spreadsheet applications throughout the curriculum, with major expansions in the Management Science and Production Operations Management areas which focus on managerial decision making, forecast scheduling, and production planning. There were also several unique applications from other academic areas. One is the Collective Bargaining Simulation from Human Resource Management, which introduced the students to the process of costing out a collective labor agreement using contract data and formulas contained in a Lotus spreadsheet. Another is the Industry Analysis Modules project which has been developed in the Organization and Strategic Studies area to assist students in their ability to analyze "ill-structured" industry situations.

Our third goal of expanded use of modeling and simulation is, like curriculum integration, well underway. And, here again, further gains are expected in the next several years as the computer proficiency of both the faculty and the students at GSM continues to expand.

6 GSM in 1990: A Sketch of the Future[10]

Subsequent to this review of recent GSM history, problems, alternatives, and experiments, I want to conclude this case study by looking ahead. I'd like to outline my image of GSM's computing environment three to five years from now. Since my crystal ball has some cloudy spots (in some places, it is very dense), I offer these remarks to help stimulate discussion. Rather than writing this scenario in the future tense, I'm writing it as if I'm looking backward from 1990. Figure 1 diagrams the major components of GSM's future technological environment.

Figure 1
GSM Projected Information Technology Base



[10] I want to thank Warren McFarland from Harvard Business School and James Moore from the Center for Expert Systems, Boston, Massachusetts, for sharing their ideas and stimulating this view of the future.

In the past few years we have moved firmly into the information age. Technologically we have established an "information network" (a local area network) linking all faculty, staff, and student workstations located within GSM. The network has the usual features of electronic mail and quality printers and plotters. However, what makes the network more than simply a physical link for workstations, truly an "information network," are the databases which are available. These databases, which cover all the areas of interest for management studies and provide data cross-referenced by industry, corporation, region or sector, and other views which enhance research and instruction, are located on the campus and School's mainframe systems. Access is also provided to real world databases, such as Dow Jones, COMPUSTAT, and CRSP, as well as to the various campus libraries. In addition, a set of School-oriented databases are available to assist students and faculty with enrollment, registration, job placement, and field study.

Our information network has had a very positive effect on the infrastructure of the School as well as on research and instruction. Electronic communication among faculty, between faculty and students, and among students is very common, and allows special interest groups to form and maintain contact easily. Electronic bulletin boards using a videotex-type system provide menu selection features and allow common mass information dissemination. The access to databases enables faculty to pose questions for student investigation, to run an analysis before class, and to display the results in class.

Starting with the class entering in Fall, 1988, GSM required all first year students to own or have easy access to a microcomputer. GSM established a purchase arrangement for students to acquire a lap-top portable at a reasonable price. Most students choose this option (even if they have a system at home) and the portables are used in classes for note taking as well as for exams, in the computer classrooms, libraries, and at home. In support of the student systems, "information kiosks" are located around the School. At these kiosks, students are able to plug their portables into the network. Other features of the kiosks are printing capability, online assistance to various software and data packages, and consulting. The traditional open-access "computer labs" from the early '80s are still around, but now with only a relatively few, very powerful systems.

Many classrooms are equipped with micro-linked video projectors so that instructors can demonstrate concepts or display "overheads" that were prepared on their office systems. Also there are several "computer classrooms" which have outlets for students to plug in their portables. What makes these computer classrooms unique is that under the instructors direction, any particular student's output can be displayed to the entire class. In this environment, a student can display his or her analysis of a case and the other students can respond.

Beginning in 1986, the MBA curriculum was significantly revised to take advantage of the information technology which had become available. The revision was organized around two efforts: curriculum area databases and major revamping of the core courses. We recognized that a major hurdle to research and instructional use of computers was the lack of access to data. Word processing and spreadsheets provided productivity gains, but the real power of the computer in assisting with qualitative and quantitative analyses was hampered by the lack of data. Software was readily available, so we chose to put our efforts into identifying and acquiring the data needed to do the various analyses. Back in 1986, it was argued that if such databases and software were made available for faculty use, these applications would find their way into various upper-level MBA courses by the end of the decade. (Happily we can say that the prediction was accurate!) Therefore, an organized effort to identify and find or create the appropriate databases was undertaken and, based on our success, will continue. This database development was given a significant boost when, in 1987, a consortium of business schools was formed to assist with the gathering and sharing of these databases.

The second curriculum revision area was that of the MBA core courses. Back in 1984, a MBA Task Force examined the core courses and made recommendations for revising them to include use of computer technology where appropriate. Building on this work, significant modifications were made to many of the first year core classes beginning in 1986. A common pattern for the revision was to change the course structure from a four unit lecture to a three unit lecture and a one unit 2-hour required and graded computer lab. These lab sections are now conducted in the "computer classrooms" and taught by area computing consultants.

Because of the tremendous time commitment needed for courseware development for the lab sessions, the faculty agreed that each core class would have common lab sessions, and for some sections, a common course syllabus. To develop these lab sessions, "core teams" were established. Each team consisted of the faculty who teach the core class, a curriculum development specialist (a system designer with an educational orientation) and an area computing consultant (a doctoral student from the area to do the programming).

The faculty are responsible for identifying objectives and making suggestions. The area consultants do the actual writing and data entry. Faculty certify that the material is, in fact, appropriate to the course material and contributes to the achievement of stated course goals. The curriculum development specialist is responsible for coordinating the efforts of the team and supervising the area computing consultant to be sure that common user interfaces and software engineering standards are achieved across all areas of the School.

A major hurdle to curriculum revision was faculty incentives. We were able to overcome some of the problems by using the curriculum development specialists and area computing consultants. Also, some senior faculty requested either a course release or summer support to assist with the development effort. Also, for some areas, adjunct lecturers were hired specifically to do curriculum development and instruction.

7 Conclusion

A major element in GSM's success is that the faculty as a whole have gained first hand experience with the technology and are beginning to believe in its potential. GSM as an organization has made significant progress along the learning curve and can collectively think and speak of the benefits of the technology from a common experience base.

The primary factors leading to the successful progress toward the achieving of our organizational goals have been individual faculty being motivated by the opportunity presented by the various grants to introduce new technological tools into their environments, combined with a strong support program to assure the effective and efficient use of these tools. The strategy for managing our implementation has been for curriculum areas to submit plans and the School to allocate resources (hardware, software, and personnel support). The success of this strategy has been due to the availability of equipment and funds through the various grants and the assistance of the campus administration in providing additional funds.

During the next few years GSM will continue to stride toward achieving its long term goals by developing additional instructional materials and support programs which lead to student and faculty proficiency and integration of information technology throughout the program. Information technology is becoming a "normal" part of the environment and it appears that a growing number of faculty members automatically think about the potential impact of technology use in their courses. Over time we see it being a natural component of most classes, especially those which use or can benefit from simulation or modeling as part of the analysis procedures of the discipline.

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Appendix A - 1

GSM Computing Budget Analysis

Appendix A

GSM COMPUTING [illegible]

NOTES: In the following budget, a zero in a locat[illegible] indicates that $0 were spent, while a blank indicates that the amount is unknown.

	FY 85 Actual	FY 86 Actual	FY 87 Projected	FY 88 Projected
TOTAL GSM COMPUTING SUMMARY				
Hardware Donations	$979,000	$1,118,799	$1,251,500	$1,692,500
Software Dontations	$33,500	$171,650	$469,800	$385,500
Expenses	$94,310	$410,549	$598,300	$600,800
Salaries *	$285,750	$530,804	$779,994	$1,171,490
OAC IBM 3090 Utilization	$294,373	$291,198	$283,000	$283,000
TOTAL GSM COMPUTING SUMMARY:	$1,686,033	$2,523,000	$3,382,594	$4,133,290
SUMMARY OF HARDWARE AND SOFTWARE DONATIONS				
Hardware:				
IBM Project ADVANCE	$21,000	$453,816	$650,000	$772,500
IBM Business School (MISSLE)	$0	$112,200	$250,000	$250,000
Hewlett-Packard	$958,000	$552,783	$351,500	$670,000
Hardware Donations Subtotal:	$979,000	$1,118,799	$1,251,500	$1,692,500
Software:				
IBM Project ADVANCE	$0	$11,365	$30,000	$30,000
IBM Business School (MISSLE)	$0	$12,100	$37,500	$37,500
Hewlett-Packard	$33,500	$82,160	$93,900	$70,000
Ashton-Tate **	$0	$66,025	$308,400	$248,000
Software Donations Subtotal:	$33,500	$171,650	$469,800	$385,500
TOTAL HARDWARE & SOFTWARE DONATIONS:	$1,012,500	$1,290,449	$1,721,300	$2,078,[illegible]

* Includes benefits and 5% inflation factor for FY 87 and FY 88.

** GSM faculty received complimentary copies of Framework II and students paid $75. Donation value based on list value of $695.

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	FY 85 Actual	FY 86 Actual	FY 87 Projected	FY 88 Projected
SUMMARY OF EXPENSES AND SALARIES				
Expenses				
Communications Equipment	$8,800	$86,832	$78,700	$78,700
Software & Data		$25,649	$43,500	$93,500
Supplies, Facilities, Furniture, etc.	$15,000	$117,043	$262,500	$142,500
Computer Maintenance and Service	$70,510	$76,848	$105,600	$178,100
Faculty and Staff Support		$104,177	$108,000	$108,000
Expense Subtotal:	$94,310	$410,549	$598,300	$600,800
Salaries				
Career Staff	$138,000	$271,689	$549,994	$872,490
Student Staff	$147,750	$259,115	$230,000	$299,000
Salaries Subtotal:	$285,750	$530,804	$779,994	$1,171,490
TOTAL EXPENSES AND SALARIES:	$380,060	$941,353	$1,378,294	$1,772,290

	FY 85 Actual	FY 86 Actual	FY 87 Projected	FY 88 Projected
SUMMARY OF FUNDING SOURCES				
Designated Computing Funds				
Vice Chancellor Research Funds				
GSM Computing General Funds (GN-36)	$0	$189,849	$199,341	$209,309
Instructional Computing (GN-05)	$0	$150,000	$150,000	$150,000
Special allocation *	$0	$70,000	$0	$60,000
IBM Business School Grant Funds (MISSLE)	$0	$187,604	$189,000	$189,000
Total designated funds:	$0	$597,453	$538,341	$608,309
Additional Funding				
GSM Operating Budget (GM-16)		$207,159		
Instructional Material Fee (GN-15)		$45,358		
Summer Session (SS-03)		$24,464	$63,000	$63,000
Executive MBA (GN-21)		$10,740		
Finance Area (GN-06)		$9,500	$9,500	$9,500
Finance Area (GN-91)		$4,899	$5,000	$5,000
Discretionary Funds		$6,780		
Total additional funding:	$380,060	$308,900	$77,500	$77,500
Funds to be identified:	$0	$35,000	$762,453	$1,086,481
TOTAL FUNDING SOURCES:	$380,060	$941,353	$1,378,294	$1,772,290

* FY 86 for data switch; FY 88 request for classroom video equipment.

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	FY 85 Actual	FY 86 Actual	FY 87 Projected	FY 88 Projected
DETAIL LISTING OF HARDWARE AND SOFTWARE DONATIONS				
IBM Project ADVANCE				
Faculty Workstation	$21,000	$344,470	$0	$225,000
Additional Peripherals	$0	$33,661	$150,000	$0
IBM 7171 Port Controller	$0	$14,080	$0	$0
Student Workstations	$0	$61,605	$400,000	$347,500
Network Equipment	$0		$100,000	$200,000
Hardware Subtotal:	$21,000	$4[illegible],816	$650,000	$772,500
Faculty Software	$0	$11,365	$10,000	$10,000
Student Software	$0	$0	$20,000	$20,000
Software Subtotal:	$0	$11,365	$30,000	$30,000
IBM Project ADVANCE Total:	$21,000	$465,181	$680,000	$802,500
IBM Business School (MISSLE)				
Grant Hardware	$0	$112,200	$250,000	$250,000
Grant Software	$0	$1[illegible],100	$37,500	$37,500
IBM Business School Total:	$0	$124,300	$287,500	$287,500
Hewlett-Packard				
HP 3000 and Upgrades	$694,000	$167,528	$68,300	$300,000
Microcomputer Workstations	$220,000	$139,235	$0	$50,000
Lap Portables		$216,000	$222,200	$220,000
Microcomputer Peripherals	$44,000	$30,020	$25,000	$50,000
Network Equipment	$0	$0	$36,000	$50,000
Hardware Subtotal:	$958,000	$552,783	$351,500	$670,000
Minicomputer Software	$6,000	$13,000	$21,000	$25,000
Microcomputer Software	$27,500	$50,850	$59,700	$25,000
Consulting and Support	$0	$18,310	$13,200	$20,000
Software Subtotal:	$33,500	$82,160	$93,900	$70,000
Hewlett-Packard Total:	$99[illegible],500	$[illegible]34,943	$445,400	$740,000

Appendix A - 3

	FY 85 Actual	FY 86 Actual	FY 87 Projected	FY 88 Projected
DETAIL LISTING OF ALL COMPUTER EXPENSES				
Communications Equipment:				
Port Selector	$0	$50,057	$43,500	$43,500
Fiber Cable	$0	$17,717	$0	$0
Wiring Installation	$8,800	$10,758	$15,000	$15,000
Data Telephones		$7,300	$7,000	$7,000
Modems		$1,000	$1,000	$1,000
Service Contracts	$0	$0	$7,200	$7,200
Software	$0	$0	$5,000	$5,000
Subtotal:	$8,800	$86,832	$78,700	$78,700
Software & Data (Purchase or Site License)				
Word Processing		$2,000	$1,000	$1,000
Spreadsheet		$0	$0	$0
Database Management System		$0	$0	$0
Graphics		$0	$0	$0
Integrated		$0	$0	$0
Micro Instructional/Miscellaneous		$2,250	$25,000	$25,000
HP3000 Software		$7,000	$3,000	$3,000
CRSP Database		$9,500	$9,500	$9,500
Compustat Database		$4,899	$5,000	$5,000
Other Databases			$0	$50,000
Subtotal:	$0	$25,649	$43,500	$93,500
Supplies, Facilities, Furniture, and Security for HP3000 and all Microcomputers				
Supplies	$15,000	$44,597	$56,500	$56,500
Peripheral Equipment		$3,400	$5,000	$5,000
Printing and Publications		$13,001	$10,000	$10,000
Security Devices		$3,834	$18,000	$9,000
Computer Furniture		$9,343	$31,000	$0
Preparation of Student Lab		$38,660	$100,000	$0
Classroom Projection Equipment		$2,500	$40,000	$60,000
Miscellaneous Equipment		$1,708	$2,000	$2,000
Subtotal:	$15,000	$117,043	$262,500	$142,500

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	FY 85 Actual	FY 86 Actual	FY 87 Projected	FY 88 Projected
Computer Maintenance and Service				
HP3000 Minicomputer Maintenance	$70,000	$24,708	$27,200	$27,200
HP3000 Software Maintenance		$19,965	$21,900	$20,000
HP Microcomputers Service		$16,032	$17,600	$17,600
IBM Microcomputers Maintenance		$0	$15,600	$80,000
Insurance		$6,763	$10,000	$20,000
OAC Installation Charge	$510	$6,780	$10,000	$10,000
OAC Disc Storage/Backup Charges		$948	$1,600	$1,600
Terminal Rental and Port		$1,652	$1,700	$1,700
Subtotal:	$70,510	$76,848	$105,600	$178,100
Faculty and Staff Support				
Professional Staff Development		$3,961	$5,000	$5,000
Faculty Course Release and Summer Support		$97,816	$100,000	$100,000
Office Supplies, Mail, Xerox., etc.		$2,400	$3,000	$3,000
Subtotal:		$104,177	$108,000	$108,000
TOTAL EXPENSES:	$94,310	$410,549	$598,300	$600,800
IBM 3090 UTILIZATION				
IUC Allocation	$291,000	$247,802	$275,000	$275,000
Extramural Faculty Usage		$38,098		
Summer Session Usage	$3,373	$5,298	$8,000	$8,000
TOTAL OAC UTILIZATION:	$294,373	$291,198	$283,000	$283,000

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